FOOD FOR LONGER LIVING

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Preface

THREE centuries ago, Francis Bacon, in an absorbing book on the prolongation of life, wrote:

> Certainly this is without all question, that *Diet* well ordered bears the greatest part in the prolongation of life. . . . Curing of Diseases is effected by Temporary Medicines but Lengthening of Life requireth observations of diets.

Nearly one and a half centuries later, J. Easton, in another interesting book on human longevity, expressed similar thoughts more explicitly in these terms:

> It is not the rich and gre[illegible]ose who depend on medicines, who become [illegible]ch as use much exercise, are exposed to the [illegible]nd whose food is plain and moderate, as farmers, gardeners, fishermen, labourers, soldiers, etc., and such men, as perhaps never employed their thoughts on the means which have been used to promote Longevity.

The same basic ideas, amplified and extended to embrace the results of recent research and more up-to-date knowledge, form the theme of this book.

R.C.H.

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Introduction

FOR centuries writers have stressed the importance of food in protecting the human body against the encroachment of old age.

Lack of certain foods was known to cause various life-shortening diseases which have since been related to the inadequate provision of certain nutrients. It is now generally recognized that nutrition is probably the most important single factor determining the rate at which the changes of ageing develop.

Because of better standards of nutrition and the conquest of many infectious diseases, people in most Western countries are now living longer than before so that there is a greater proportion of the population in these countries living beyond the normal retiring age of sixty-five years. Furthermore, the end of this trend is not in sight. The impetus being provided by the discovery of new drugs and antibiotics, effective in the conquest of additional infectious and degenerative diseases, gives promise of a further extension of human longevity. Nevertheless, many comparatively young people still die from degenerative diseases, and there is convincing evidence that some of these diseases are closely related to the pattern of nutrient intake.

Modern research has led to the conclusion that the attainment of old age is conditioned by heredity and, furthermore, that this factor is dominant. Thus, if one or both of the parents reach old age, their children may do likewise. But few persons live in circumstances so ideal that they reach the maximum possible age. Life is fre-

quently shortened by such factors as worry, overwork, accident, disease and, especially, immoderate eating and drinking.

The value to society of prolonging an individual's potential work capacity, and hence physical independence, is accepted, but, although food is regarded as one of the most important factors involved, little has been done to investigate the food and feeding patterns most suitable for the purpose. Much more has been done to determine nutritional requirements during growth. This is, no doubt, due to the fact that growth itself is so obvious a phenomena and so easily measured that nutritional studies are simpler than in adult life when the criteria of good nutrition are much more difficult to define.

Ageing is the progression of the organism towards its final end. It commences while one is quite young, although many years may elapse before the first external signs become evident. If food is to play its greatest role in prolonging life, attention must be paid to eating habits before the effects of ageing become evident. Unfortunately, it is not until the signs of ageing have appeared that most people give consideration to the remaining years. By this time, corrective action is more difficult, largely because certain irreversible physiological changes have already commenced, and partly because many people have become more set in their food habits.

Although it is doubtful whether one and the same diet can be optimum for growth, breeding and longevity, there are no specific foods that are known to prolong the life of a healthy individual. Many claims have been made by faddists and others but these claims are without scientific support. Human nutrition is much the same at all ages and it is only in the quantitative relationships that there are appreciable differences. There are conflicting opinions regarding the ability of the aged organism to

absorb certain water-soluble nutrients, and hence the quantities required, and considerable effort has been directed towards investigating such matters. It is generally agreed, however, that high caloric intakes and high levels of dietary fat have, as a rule, adverse effects on the life span.

People who have reached maturity, or so-called middle age, tend to follow the dietary patterns of younger years when habits were being formed. This could be largely responsible for a higher degree of malnutrition in middle-aged and older people. In elderly people, mental conditions such as apathy and forgetfulness may lead to monotonous or inadequate diets which, in turn, can also result in malnutrition. Those living on meagre retirement pensions, calculated to cover only the bare necessities of life may, when prices rise, suffer from malnutrition through lack of knowledge of what foods are best to buy. The amount of money spent on food is not nearly as important as the way in which it is spent. Several recent surveys have emphasized the relationship between poverty, malnutrition and old age.

The border-line of malnutrition may often be approached as a result of economic factors, that is, insufficient money to buy sufficient food, whereas frank malnutrition is likely to be precipitated by ignorance of what constitutes an adequate diet as well as by dietary prejudices and ingrained habits. Undesirable amounts of starchy foods may be purchased because they are cheap and easy to prepare. Unsatisfactory housing, mental depression and loneliness could be other important factors influencing food intake.

In general, satisfactory diets can be planned by carefully following food guides prepared and distributed by government agencies and other instrumentalities. To be able to plan more varied diets that are nutritionally ade-

quate as well as being attractive and palatable, an elementary knowledge of nutrition is necessary. This can be acquired without much effort by the average person. More pertinent facts are covered in the next chapter. Detailed information may be found in many textbooks on nutrition.[1] Some cookery books contain a chapter on the subject.

An elementary knowledge of nutrition would also assist people in countering the claims of food faddists, manufacturers of special rejuvenating foods and writers of articles in which impossible results are promised those who follow certain diets. Middle-aged people, when they first observe degenerative changes in themselves, are particularly vulnerable. In fact, the greater the feeling of deterioration, the stronger the urge to try anything that promises relief. Most of the publicized foods and diets are harmless, but often they induce people to spend money that could be better spent on more nutritious foods.

The nutrition of the middle-aged man or woman is rendered particularly complex because of many interrelated factors that extend into social and economic conditions and which are the effect of changing mental outlooks and, in some instances, the commencement of various pathological conditions. After the attainment of middle age, the body becomes more and more subject to the diseases resulting from the régime followed during the first half of life. Furthermore, the diseases that usually accompany ageing begin to appear. These diseases induce strains in the physiological mechanism and make the evaluation of factors resulting from dietary variables very difficult.

Nevertheless, the middle-aged group is probably the

[1] See R. C. Hutchinson, *Food for the People of Australia* (Sydney, 1958).

most important section of the population. It is this group that determines the standards by which all people live. Those living at the extremes of the life span, that is the children and older people, are largely at the mercy of what the middle-aged group decides. The young and the old have various degrees of helplessness and a destiny determined largely by the wishes of middle-aged people. Of course society functions most adequately when all ages are represented in its structure. The younger members are stimulated by competition but they also need the support and sustaining assurance of older members. The older members give stability and continuity to the structure and, in turn, derive psychological encouragement and physical invigoration from contact with younger associates. If the older person is to play his part, and not be a burden to the rest of the structure, he must be adequately nourished and in the best possible health.

I

Nutrients and their Sources

An elementary knowledge of nutrition will make the reading of this book much easier and enable its contents to be better understood. It will also serve as a means of defining and explaining some of the simpler scientific terms to be found in all books on food and nutrition.

Most foods consist largely of water with which there is associated certain major food solids and minor constituents. These may be either contained in the water, as in the case of most fluid foods, or they may combine to form a structure in which the water itself is contained, as in the case of most solid foods. The solidity of a food, however, is no indication of its water content. For instance, some solid foods such as tomatoes may contain over 90 per cent water, whereas some liquid foods such as cream may contain less than 60 per cent.

In addition to water, foods consist of five components which, for convenience, may be divided as follows:

Minor Constituents
  Vitamins
  Mineral Salts
Major Food Solids
  Proteins
  Carbohydrates
  Fats

The minor constituents are listed first because they are more likely to be deficient in many adult diets. For

the same reason, proteins head the list of major food solids. Both the minor constituents and major solids may be further divided into about fifty nutrients all of which are required in various amounts by the human body. The more important will be discussed hereunder.

MINOR CONSTITUENTS

The only property shared by vitamins and mineral salts is their presence in foods in comparatively small amounts.

Vitamins

These are potent organic compounds, one or more of which occurs in minute quantities in most natural foods of animal or plant origin. They are of particular dietary importance because they serve to make possible the more efficient utilization of other food components. They differ from each other to such an extent that there is little justification for their common designation, the term 'vitamin' having been introduced before their true identity was known.

At first, the individual vitamins were named by letters to which numerical subscripts were added later. The present trend is towards the use of scientific names descriptive of each substance. However, the lettered nomenclature is still retained for some purposes and, because of its simplicity, will be used in the discussion that follows. It is sometimes convenient to group the vitamins according to their solubility, the fat-soluble vitamins including vitamins A and D, and the water-soluble, various vitamins of the vitamin B group and vitamin C.

As the name implies, the fat-soluble vitamins are to be found in various fatty foods such as butter, eggs and sardines and, in the case of vitamin A, in many green, leafy and yellow vegetables, and some yellow fruits,

where it exists in an unformed condition. Vitamin A is just as useful to the body in the unformed condition so that it is not essential to consume fatty foods in order to obtain adequate amounts, provided sufficient quantities of certain fruits and vegetables are included in the diet. It is, however, necessary to consume fatty foods for other reasons which will be discussed later.

One of the earliest signs of vitamin A deficiency is a visual disturbance in light-dark adaptation, commonly known as night blindness. For instance, a person may be unduly conscious of the glare of headlights when driving a car at night. Of course the eye is not the only organ affected. There may also result a rough, dry and scaly condition of the skin as well as an unpleasant condition of the membranes lining the nose, throat and other air passages. Vitamin A deficiency must be severe or prolonged before such changes occur.

Another important fat-soluble vitamin is vitamin D which is to be found in large amounts in several animal fats, such as shark and cod liver oils. It is also found in egg yolk and butter fat. It can be formed in the body during exposure to sunlight. Vitamin D assists in controlling the mechanism of bone formation so as to make possible the most efficient utilization of the other elements involved. Lack of vitamin D could be partly responsible for 'adult rickets', a degenerative change common in elderly people.

The water-soluble vitamins of the vitamin B group are distinguished by subscripts, for example, B_1, B_2, etc. and, together, are sometimes referred to as the vitamin B complex. Certain properties, such as their solubility in water, and distribution in many familiar foods, are common to all members of the group. The fact that several occur together in the same foods gave rise to the early erroneous idea that they comprised only one substance.

Some members of the vitamin B group can be manufactured by bacteria in the intestines. For these, the amounts included in the diet are not a reliable measure of the amounts available to the body.

Vitamins of the B group are necessary for the efficient release of energy from other components in the diet. A mild deficiency may be responsible for loss of appetite, premature fatigue and various nervous conditions. A more pronounced deficiency could be responsible for well-known diseases such as beri-beri or pellagra, which are not common in the more advanced countries. Few foods contain large amounts of B-vitamins, but in a mixed diet many foods contribute small amounts and so build up an adequate supply. The cereal foods usually contribute the largest amounts particularly if prepared from whole grain. Meats and milk may also contribute considerable amounts. Pulses and nuts are good sources but usually contribute comparatively little because of the small amounts consumed.

Because they are water-soluble, considerable amounts of the B-vitamins may be leached from foods during certain cooking processes. To reduce this loss, the water in which such foods as fruits and vegetables have been cooked should be kept to a minimum and, later, as much as possible used as stock for the preparation of soups, gravies and sauces. Part of some of the B-vitamins may be lost because of the heat applied during cooking.

Vitamin C, which is classically associated with scurvy, has several functions in the body. One concerns the formation and maintenance of the inter-cellular cement-like substance of many tissues. If insufficient vitamin C is provided, there may be haemorrhages of varying degrees. Haemorrhage, and an interference with the functioning of the blood-forming cells in the bone marrow, may re-

sult in anaemia. Vitamin C is also essential for the normal healing of wounds.

Vitamin C is to be found in varying amounts in most fresh fruits and vegetables. Especially good sources are citrus fruits and tomatoes. Of all the vitamins it is the most unstable and easily destroyed. Appreciable amounts may be destroyed during the storage and cooking of food and, when fruit and vegetables are boiled in water, large amounts may be leached into the cooking water. Because of this, as much of the cooking water as possible should be used in the preparation of other foods. Foods containing vitamin C should be consumed each day as the body can store only small amounts of this vitamin.

It is believed by some people that the absorption of vitamins is impaired as one grows older. With a possible exception to be discussed later, no clear-cut demonstration of this has been reported. Nevertheless, when available foods are low in any vitamin, an insufficient intake of this vitamin is more likely to result in older persons than in young because the caloric requirement and hence the total food consumption of the older person is usually smaller. Also, of the foods that are available, an older person may choose those that can be masticated with least effort, and these are frequently prepared foods with a comparatively low vitamin content.

Hence, for the older person, the problem does not appear to be one of increased vitamin requirements but of an altered dietary pattern which causes a decrease in the amounts of vitamins ingested.[1] For those in a poor state of nutrition, an improved dietary pattern, embracing foods from all the recommended food groups, is generally indicated.

[1] M. K. Horwitt, 'Dietary Requirements of the Aged', *Journal of the American Dietetic Association*, 29, 443 (1953).

Mineral Salts

Mineral salts are inorganic compounds containing mineral elements, the greatest amounts being found in the bones. In natural foods they are provided in various forms frequently mixed or combined with other components. Although twenty or more mineral elements are known to be essential in human nutrition, most available information relates to calcium, phosphorus and iron. Of these, calcium is the mineral element most likely to be deficient in many adult diets, and iron in the diets of many women.

Most of the calcium present in the human body, and a large percentage of the phosphorus, is present as normal constituents of bones and teeth. Smaller amounts perform many other less conspicuous but even more basic functions. There is some evidence that old people have difficulty in the absorption and utilization of calcium and that ageing is associated with an increase in the calcium content of certain tissues. The bones of old people fracture easily, and the fact that many fractures result from comparatively mild accidents implies an increased fragility of bone with increasing years. This may be due to poor calcium utilization, a calcium deficiency in the diet, or a deficiency of some other nutrient, such as vitamin D.

Milk and milk products, excluding butter, are excellent sources of calcium and the calcium intake of many adults is low largely because they dislike these foods. Others regard the drinking of milk as childish and do nothing about the inclusion of milk products as components of other foods in the diet. Unless appreciable amounts of milk in one form or another, or cheese, are consumed each day, many adults would find it difficult to maintain an adequate calcium intake. Nevertheless, during a recent study conducted to discover a relationship

between dietary intake and bone fragility in the aged, no significant difference was found in the adult eating habits of people with fractured and non-fractured bones. Neither was there any significant difference in milk consumption during childhood of people in these two groups.[2]

The results of this study appear to support the hypothesis that the onset of bone fragility in the aged is a composite effect of many factors and is probably more intimately related to glandular changes, decreased activity and loss of muscle tone than to level of nutrition. Much more research is necessary before the cause can be determined with reasonable accuracy.

Calcium and phosphorus are usually considered together because they frequently function together in the body although they are not always found in the same foods. Milk and milk products, with the exception of butter, are excellent sources of both. Most green leafy vegetables contain considerable amounts depending partly on the soil on which they were grown. Phosphorus is more widely distributed than calcium and less likely to be deficient in the average diet. Meats, poultry, fish, cereals and nuts, as well as whole milk and green leafy vegetables, are good sources.

Tables giving the calcium content of foods may be of limited nutritional value because they do not always give information about the relative availability to the body of the calcium in each item. In certain foods and under certain conditions, calcium may be completely unavailable because it is combined in an insoluble or indigestible form. This is the case with calcium in spinach and, to a

2 O. B. Hayes, L. J. Bowser and M. F. Trulson, 'Relation of Dietary Intake to Bone Fragility in the Aged', *Journal of Gerontology*, *11*, A, 154 (1956).

lesser extent, in silver beet. Hence, the consumption of spinach is not recommended.

Iron is another mineral element that may be low in some adult, and particularly female, diets. It is a necessary constituent of the pigment that gives blood its red colour, and a deficiency may cause anaemia. It is rigidly conserved by the body and may be used repeatedly. Rich animal sources are liver, oysters and various meat products; green leafy vegetables are the best of the plant sources. An average mixed diet containing a variety of foods would normally contain adequate amounts of iron.

Owing to leaching, there may be small losses of calcium, phosphorus, iron and other mineral elements during the cooking of vegetables and fruits in water. This loss is prevented if the cooking water is used as stock for soups and gravies. In some homes, it may be difficult to use all the cooking water that becomes available each day. The mineral elements are not destroyed by heat.

Common table salt, containing the mineral element sodium, is usually present in abundance in the average diet with a frequent tendency to over-consumption. It is for this reason that it warrants brief mention. Additional salt is not usually required except under the following conditions—when hard work is performed in a hot environment, resulting in the production of considerable sweat. Under such conditions, additional salt may be needed to replace that lost in sweat, but it should always be taken together with additional water. In a temperate climate these conditions are not common and, for most adults, the tendency should be to reduce rather than increase salt intake.

MAJOR FOOD SOLIDS

Of the major food solids, protein deserves first consideration largely because it is a dietary essential, and

also because it is more likely to be supplied in inadequate amounts than carbohydrate or fat, especially by adults on low or restricted incomes.

Proteins

Proteins, like mineral salts and vitamins, provide essential nutrients that cannot be provided by other food components. All contain nitrogen which is their distinguishing characteristic. They form the basic structural material of every cell in the body. As the body is dependent upon food protein for the supply of essential nutrients to make body protein, it is apparent that the quantity and quality of the protein in the daily diet are of prime importance.

Proteins may be obtained from either animal or plant sources, those from the former having the higher biological quality. All proteins consist of nitrogen-containing compounds known as amino acids. There are twenty-two amino acids of which ten are believed to be essential in human nutrition. Of these, two are of doubtful significance to adults although necessary for growth in children. In natural foods, proteins differ widely in the number and proportion of amino acids they contain. For adults, high quality proteins would contain appreciable amounts of all amino acids necessary for body maintenance.

In general, proteins from animal sources, such as meats, poultry, fish, eggs, cheese and milk, provide high quality material in liberal amounts. On the other hand, proteins from plant sources such as nuts, beans and peas, are usually of lower biological value, the amino acid structure of plant cells differing widely from that of animal cells. However, most diets contain a mixture of proteins, one or more of which may serve to supplement deficiencies in others. For instance, cereals, which are lack-

ing in one or more essential amino acids, are usually consumed with milk which has an abundance of these acids.

In addition to their role in the maintenance of body tissue, proteins provide the body with some energy for warmth and muscular activity. One ounce of protein provides about 113 Calories, a calorie[3] being a measure of heat released in the same way that a mile can be a measure of distance travelled. In most Western-type diets, proteins provide about 11 or 12 per cent of the total calories consumed.

In the form in which they are usually found in fresh foods, proteins readily decompose at room temperature and may form products that are poisonous. For this reason it is more important to store high protein foods (such as meat, poultry or fish) in a refrigerator than it is high carbohydrate or fatty foods which, for short periods, are comparatively stable. During normal cooking procedures, proteins are rendered more stable, although in some instances their quality may be lowered.

The protein requirements of the middle-aged or older person are not accurately known. There is little experimental evidence that as people grow older their protein requirements differ appreciably from those of younger individuals. Nevertheless, it is generally agreed that elderly people do better on a protein intake higher than their caloric requirements suggest. Hence, a daily allowance of one ounce of protein per sixty-three pounds of body weight (or one gram per kilogram of body weight) should be sufficient for most adults of all ages. Some investigators have recommended a higher figure. It has been pointed out that difficulties may be encountered in maintaining elderly persons for long periods on intakes

[3] The caloric content of foods is always expressed in large or kilocalories. When used to define a specific number of calories, the term is spelt with a capital C.

greater than one and a half ounces per sixty-three pounds body weight.[4]

Dangers from the ingestion of large amounts of protein in the form of meat by middle-aged people appear to have been overemphasized in the past. Although the experimental results are conflicting, there is much evidence that a moderately high meat diet does no harm.

Because protein foods are more expensive than carbohydrate and because they are sometimes more difficult to masticate by people with bad teeth, or ill-fitting dentures, there is, particularly in old people, a tendency to reduce consumption below the above figure of one ounce per sixty-three pounds body weight. This is most unfortunate and could result in habitual fatigue or, if the deficiency is severe, considerable tissue wastage.

Carbohydrates

Carbohydrates are an important source of energy for warmth and muscular activity, being the cheapest and most easily digested of all food components for this purpose. Like proteins they provide approximately 113 Calories per ounce. If consumed in excessive amounts, carbohydrates may be converted to body fat. For convenience, they are frequently divided into two groups—the soluble and insoluble.

The soluble carbohydrates consist of single and double sugars. The single sugars, which include glucose, require no digestion but are readily absorbed from the intestine into the blood stream. The double sugars, which include ordinary cane sugar, have to be first broken down into single sugars before they can be absorbed. Lactose, the double sugar found in milk, is of particular value because it appears to increase the absorption of calcium.

4 W. B. Kountz, P. G. Ackermann, T. Kheim and G. Toro, 'Effects of Increased Protein Intake in Older People', *Geriatrics*, *8*, 63 (1953).

The insoluble carbohydrates consist of starches and fibrous materials often referred to as fibre. The starches found in grains, vegetables and other plant products are usually enclosed in a fibrous coating which is more or less resistant to digestion. This coating must be broken down before the starch can be utilized by the body. When starch granules are cooked in water, the outer coatings burst and this releases their starch content. The fibrous coatings provide little food that can be absorbed into the blood stream although they supply nutriment to the intestinal bacteria which produce appreciable quantities of certain B-vitamins. Fibre also provides bulk which is often necessary for the efficient and normal muscular contractions of the intestines.

Important sources of carbohydrates are grain foods, such as bread, rice and oatmeal. Cakes and confectionery items also contain considerable amounts, as well as such foods as jams and sugar. Unlike most other carbohydrate foods, cane sugar is a refined product and it does not have associated with it any of the vitamins essential for its efficient conversion to energy. By some people, sugar, in the form of confectionery items and sweets, is consumed in greater quantities than any other carbohydrate, often to the detriment of health. This is partly because it satisfies appetite and thus reduces the desire for other more nutritious foods, such as bread, milk, fruit, and meat.

Gradually, with increasing years, there appears to be a strong tendency for many people to substitute carbohydrate for protein. The reasons for this are probably complex. They often involve social and economic factors such as loss of interest in the preparation of food, and the high cost of meat and other protein foods, as well as fuel. Furthermore, the teeth may be such as to make

chewing difficult or unpleasant. Carbohydrate foods require little chewing.

Fats

Fats include vegetable oils that are fluid at normal room temperature and animal fats that are solid. Both have many similar properties and are insoluble in water and greasy to touch. They should not be confused with mineral oils and greases which have no food value and are objectionable because of their interference with the absorption of fat-soluble vitamins.

In a mixed diet, fats serve a multiple purpose. Some act as carriers of fat-soluble vitamins and all improve the satiety value of a food as well as its palatability. They are a concentrated source of energy, one ounce providing about 255 Calories, or more than twice the amount provided by an equal quantity of protein or carbohydrate. Hence, they are of value in providing a high calorie meal in a compact form.

After fats have been absorbed into the body they are stored in depots to be drawn upon as required. The storage of small amounts of fat may be of value in assisting to regulate body temperature and in protecting the body against external injury. On the other hand, if the depots are too large, obesity results and this places an unnecessary, and for persons over thirty years of age, a very undesirable burden on the heart owing to the increased work necessary to move the body or its parts. It also necessitates additional work during the expansion of the chest in breathing and it interferes with the return of blood to the heart thus progressively restricting activity.

In natural fats there are a number of different fatty acids which give to each fat its particular taste and texture. Two of these fatty acids appear to be essential for

human nutrition although their functions are not clear. They are known to be constituents of most food oils as well as egg yolk and certain meat products. An average diet usually contains adequate amounts.

DAILY FOOD GUIDE

To assist in planning daily diets containing all essential nutrients in satisfactory amounts, food guides have been prepared. These divide foods into various groups and specify the minimum quantities that should be consumed from each group every day. Some food guides divide foods into as many as eleven groups but these are usually prepared for special circumstances involving the feeding of large numbers of people. Food guides prepared for the use of families, in which there are several young people, may divide food into five groups, namely:

(i) Milk and milk substitutes;
(ii) Bread and cereal products;
(iii) Fresh fruits and vegetables;
(iv) Meats and their substitutes;
(v) Butter and table margarine.

When, however, the food guide is to be used by fully grown adults only, the last group may be omitted on the understanding that butter and margarine will be added to other foods to complete meals and provide additional energy as required. In this case, it is important that the intake of green leafy and yellow vegetables be adequate otherwise the diet may be deficient in vitamin A.

For the main part of a diet, foods should be selected every day from the four broad food groups, discussed hereunder, and in the quantities indicated. To these, other foods can be added as required to make meals more attractive and satisfying. It is important, however, to

select at least the minimum number of servings from each of the following four food groups every day.

Milk and Milk Substitutes

Adults should consume about two cups of fresh milk per day, or an equivalent amount of several substitute foods of similar food value. Whole milk contains all essential nutrients although it has some in comparatively small amounts. It is a particularly good source of calcium. Perhaps the most valuable substitute is fresh skim milk. Skim milk is whole milk from which the fat with its fat-soluble vitamins has been removed in the form of cream. If the consumption of liquid milk is not convenient, an equivalent amount of evaporated or powdered whole or skim milk may be consumed as ingredients of various prepared foods. Equivalent amounts can be deduced from the directions on the container. Other substitutes for whole milk include cream and ice-cream. Cream contains all the solids in whole milk but with the fatty solids greatly increased. In addition to all milk solids, ice-cream contains an appreciable amount of cane sugar.

Bread and Cereal Products

At least two servings of bread, or cereal products, should be included in the diet every day, one medium-sized slice of bread, or half a cup of cooked cereal being taken as one serve. Ordinary white bread is a nutritious food but wholemeal bread is more nutritious because it contains more B-vitamins and other nutrients. In fact, this applies to all baked goods made from wholemeal flour. Porridge is another nutritious whole grain food. Some ready-to-eat breakfast cereals are enriched with various nutrients (this would be shown on the package); others, though palatable, have low nutritive values. Spaghetti, macaroni, noodles and rice are other cereal products

with high nutritive values. Cereal foods are expected to furnish worthwhile amounts of iron and B-vitamins as well as provide considerable amounts of energy and some protein. They may also contain appreciable amounts of fibre.

Fresh Fruits and Vegetables

From this group, there should be four or more servings consumed each day. These should include citrus fruits, tomatoes or other fruits or vegetables important as sources of vitamin C and a green leafy or yellow vegetable, such as broccoli or carrots, or a fruit, such as apricots or cantaloup, to provide sufficient vitamin A. Potatoes, because of the large quantities eaten, can become quite important sources of vitamin C as well as providing worthwhile amounts of vitamin B_1. Their nutritive value is highest when cooked in their jackets. Vegetables of outstanding food value are borecole, broccoli, cabbage, carrots, cauliflower, chinese cabbage and turnips (tops and roots). On the other hand, there are many fruits with a higher food value than apples whose principal virtue appears to be in giving bulk to the diet. Most fruits and vegetables are important because of the vitamins and minerals they contain. Some, such as potatoes, also provide considerable amounts of carbohydrate and others, such as beans and peas, appreciable amounts of protein. Beans and peas also contain calcium; iron and several of the B-vitamins.

Meats and their Substitutes

One or more servings, equivalent to three ounces or more of lean cooked meat, should be consumed each day. Meats may include beef, veal, mutton and lamb as well as poultry, game and fish. Livers, hearts and kidneys are also

valuable meat foods. Substitutes include eggs, cheese, lentils, dried peas and beans, and nuts and nut foods such as nut loaf and peanut butter. The foods in this group are of particular value because of their high quality protein contents. They also provide iron and various B-vitamins. The fat content of meat would depend largely on the degree to which meat is trimmed. Even carefully trimmed meat contains some fat. Because of their high fat contents, bacon and pork are not usually included in this group.

2

Bodily Changes with Increasing Age

An essential property of the living body is its ability to maintain itself, that is, to repair and reconstitute its various parts. It is this capacity for self-synthesis that divides the living from the non-living. The fact that the body cannot reconstitute itself indefinitely is proof that there are fundamental bodily changes associated with the process of ageing.

Once it was believed that every cell and organ, as well as the body as a whole, inevitably became old. It is now known that individual cells, and excised portions of tissue, may be cultured and kept alive indefinitely and are, therefore, potentially immortal. Corresponding tissues in different individuals may age at different rates, apparently youthful tissues having been found in some quite old individuals. Thus there is convincing evidence that, whatever ageing may be, it is not a necessary phenomena as far as individual cells and isolated tissues are concerned.

As far as individuals are concerned, there is also an increasing personal divergence with age. No two people experience the same illnesses, injuries, stresses and emotions, and such inevitable vicissitudes make people become increasingly different as they become older. They become accustomed to different kinds of food and may adapt themselves to different levels of nutrient intake. Hence the nutritional status and requirements of adults may differ widely and it may be not only misleading, but

actually dangerous, to employ some of the broad generalizations used for younger people.

Furthermore, tolerance to stresses of all kinds is diminished in older people. They cannot adjust themselves as well as children and adolescents to extremes of temperature, irregularities in food consumption and lack of regular fluid intake, or on the other hand, the very rapid consumption of fluids. They provide less sensitive indications of dietary deficiencies and the criteria for nutritional ill-health may become even less reliable and more difficult to detect than in young people.

Maturity, or middle age, is the longest of the periods of life and hence changes proceed at a slower rate than during childhood and adolescence on the one hand, and senescence on the other. Maturity is an undefined period commencing comparatively early in some people and continuing until much later in others. It is during this period that changes due to ageing first become evident, although they would have commenced much earlier.

CHANGES IN BODY COMPOSITION

Throughout maturity there is usually a general increase in total body weight accompanied by changes in the relative amounts of various soft tissues. It has been established that the increase in body weight during maturity is largely the result of an increase in the amount of fatty tissue and a decrease in the amount of lean tissue, the former being greater than the latter. During the age period from twenty-five to fifty years, it has been estimated that the rise in body weight may normally amount to thirteen and a half pounds.[1]

The general age trend of the relative fatness of the

[1] J. Brozek, 'Changes of Body Composition in Man during Maturity and their Nutritional Implications', *Federation Proceedings*, *11*, 784 (1952).

human body has been the subject of considerable investigation. There appear to be two maxima in fat content, one occurring in early childhood and the other in late maturity. The accumulation of fat during maturity can hardly be regarded as nutritionally desirable even though it is normal in a statistical sense. It is probably the result of appetite not diminishing at the same rate as bodily activity with its consequent reduction in energy expenditure.

The average fat content of a large number of men of

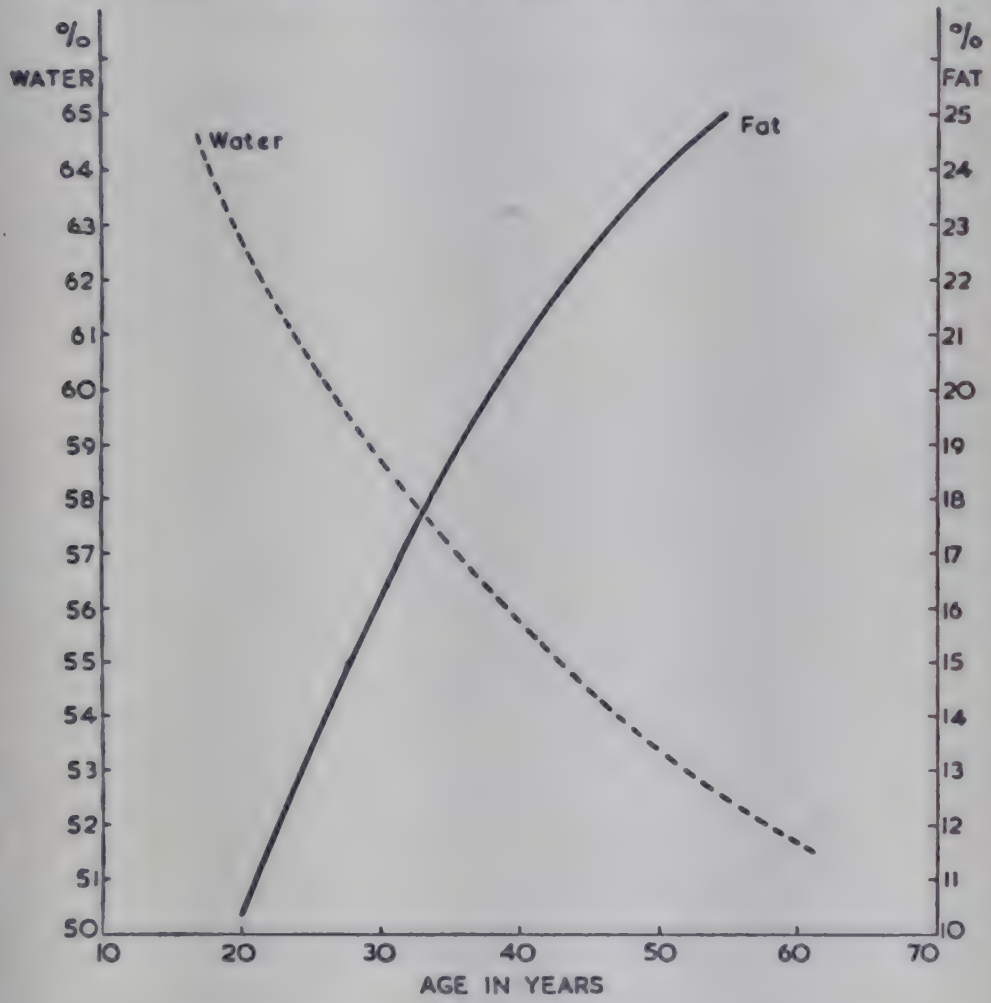

FIG. 1. Changes with Age in the Fat and Water Content of the Human Body.

standard weight whose ages ranged from twenty to fifty-five years is shown in Figure 1.[2] The men were all of the clerical and professional class. From this graph it will be seen that the older men tended to be much fatter than the young, the difference being of the order of 15 per cent of body weight contributed by pure fat.

The decrease in the amount of lean tissue may be the result of several factors. It is almost certainly partly due to reduced activity, since muscle decreases in bulk when not used or used to a lesser degree than formerly. It may be partly due to a reduced protein intake or failure to masticate, digest or properly absorb all the protein that is consumed. It could also be partly due to an insufficient consumption of protein of high biological quality. In all probability it is a combination of several such factors.

With increasing age, many of the cells of the body lose their original capacity for retaining water. The body appears to dry up as it becomes increasingly incapable of holding water in the cells of its skin, muscles and internal organs. The total amount of water in the body of a young child may be almost as high as 90 per cent whereas in a mature adult it may be considerably less than 70 per cent.

A rough indication of the rate at which body water decreases with age is also given in Figure 1. The graph was drawn from the results of several independent investigations and covers only a small number of male subjects.[3] Information on the water content of the human body is surprisingly scanty.

[2] J. Brozek and A. Keys, 'Relative Body Weight, Age and Fatness', *Geriatrics, 8*, 70 (1953).

[3] See: R. M. Forbes, A. R. Cooper and H. H. Mitchell, 'The Composition of the Adult Human Body as Determined by Chemical Analyses', *Journal of Biological Chemistry, 203*, 359 (1953); N. Pace, L. Kline, H. K. Schachman and M. Harfenist, 'Studies of Body Composition', *Journal of Biological Chemistry, 168*, 459 (1917); *Symposium on Problems of Gerontology*, Nutrition Symposium Series No. 9 (National Vitamin Foundation Inc., New York, 1954).

The decrease in water content may not be wholly owing to a reduced capacity of the cells to hold water. During maturity, it could be partly owing to the increased deposits of fat which contain less than 20 per cent water whereas muscle may contain as much as 75 per cent. The reduced water content of the body during maturity does not mean that water consumption should be decreased. On the other hand, an increased water consumption may be advantageous, as will be shown later.

Another characteristic feature of ageing is a progressive demineralization of the skeleton. This does not appear to proceed at an equal rate in all bones in the body. In general, the skeleton appears to increase in weight until the age of about thirty-five years, then it decreases gradually until about sixty-five years, after which it decreases at a continuously increasing rate.[4] At the same time, the bones become more brittle owing to loss of calcium and changes in the manner in which the calcium is chemically combined. This is accompanied by a deposition of calcium salts in various other tissues in the body.

There is a popular belief that old people are anaemic, because they presumably have insufficient iron, and terms such as 'senile anaemia' have been frequently used. From a statistical analysis of the results of complete blood and bone marrow examinations of 150 men and women between the ages of sixty-five and ninety-nine years, it has been concluded that anaemia is not one of the physiologic changes that normally occur during ageing.[5]

CHANGES IN BODILY FUNCTIONS

It is common knowledge that adults do not become as hungry as children and adolescents. In addition to their

4 W. Hobson, *Modern Trends in Geriatrics* (London, 1956).

5 N. P. Orchard, 'Blood Changes in the Aged', *Geriatrics, 10*, 459 (1955).

requirements for the formation of new tissue, young people are usually more active than adults and their body surfaces are larger in proportion to body weight, and hence they lose proportionately more heat. All these factors call for greater quantities of food.

Furthermore, with increasing age, appetite tends to become dulled. Appetite is an experience and differs from hunger which is a primary sensation. This dullness in appetite may be partly the result of a diminution in the senses of smell and taste, although in some old people these senses may still remain very acute. Appetite can often be whetted by the greater use of certain condiments, the consumption of more strongly flavoured foods, or of a small amount of alcoholic beverage.

Loss of teeth may interfere with proper mastication, portion of the food consumed being swallowed in lumps that do not allow proper digestion. Also, when food is not properly masticated, there could be a resultant irritation of the bowel. However, poor dentition does not always affect dietary intake as some people can masticate well with their gums alone. In any case, the consumption of large quantities of soft, easily masticated foods may not always be desirable as a preponderance of such foods could readily cause constipation.

It is a common observation that the flow of saliva is diminished as one grows older and there are certain changes in the salivary glands. It has been found that the production of saliva and the ability to digest starch are diminished after the age of about sixty years.[6]

After food leaves the mouth, where it has been chewed, moistened and partly digested, it is swallowed and enters the stomach. It may remain in the stomach for as long as two or more hours depending largely on its consistency

[6] See W. Hobson, *op. cit.*

and composition—watery foods leaving the stomach sooner than drier foods, and foods with a low fat content sooner than fatty foods. In the stomach, food becomes permeated with an acid gastric juice in which there are a number of active principles that continue the digestive process.

There are some indications that from the age of about twenty years, the volume and acidity of the gastric juice decreases.[7] In middle-aged people, there is no evidence that this, in general, adversely affects digestion although it may take longer. In elderly people, however, the changes may be sufficiently pronounced to cause considerable interference with digestion. In particular, they may reduce the amount of calcium available to the body.

When the stomach is nearly empty, hunger contractions become more pronounced. They occur periodically with increasing frequency and intensity until more food is consumed. In a young child, hunger pangs may be sufficiently pronounced to make it cry; in an adult, they produce an uncomfortable feeling of emptiness with which there may be associated increased nervousness and reduced ability for mental concentration.

The periods of relative quiescence of the empty stomach are shorter in the younger person and increase with advancing years while the periods of active contraction shorten, the contractions themselves becoming gradually feebler. This modification in contractions does not appear to cause any significant change in the emptying time of the stomach and there appears to be no appreciable lowering of satiety value for meals of similar composition and consistency.

After food has been mechanically broken down and chemically digested, it must be absorbed into the blood

[7] E. J. Stieglitz, *Geriatric Medicine* (Philadelphia, 1943).

stream before it can function in nourishing the body. With the possible exception of a little water, no absorption takes place from the mouth and very little from the stomach. Nearly all of the digested food material is absorbed through the walls of the small intestine, the absorbing surface of which is greatly increased by the presence of numerous finger-like projections.

There is no conclusive evidence that the absorption of protein changes with increasing years. In one experiment conducted in an institution for old people, it was found that there was a low level of protein in the blood plasma and this could not be correlated with a lack of essential amino acids or a lower protein intake in relation to body weight.[8] Hence, it could be interpreted as suggesting a slower absorption or greater utilization of protein. There is no evidence that, as a person becomes older, there is any falling off in protein requirements: protein requirements may, in fact, be slightly greater.

There is definite evidence of a change in the absorption and utilization of carbohydrate with age. The response to the ingestion of small quantities of glucose is different in young and older adults. The older adult usually shows a later and higher concentration of sugar in his blood and the consequent fall in concentration is much slower. In fact, the variation in the concentration of glucose in the blood of an older adult may be such that in a young person it would be regarded as indicative of diabetes. The obvious explanation is that, as one grows older, the absorption of glucose and its subsequent utilization within the body becomes less efficient. Other factors, of course, could be involved.[9]

[8] O. Olbrich, 'Blood Changes in the Aged', *Edinburgh Medical Journal, 54*, 649 (1947).

[9] C. P. Stewart, 'The Biochemistry of Senescence', *British Medical Journal, 11*, 569 (1947).

There are also definite indications that the absorption and utilization of fat are delayed. It has been demonstrated that after a fatty meal the concentration of fat particles in the blood remains at a higher level for a longer period in old people than in young. Due to delayed gastric emptying time there may be considerable flatulence and discomfort. Consequently, some old people may tend to avoid fatty foods and, when this is so, it is necessary to ensure that sufficient quantities of fat-soluble vitamins are available from other sources, such as yellow and green leafy vegetables, otherwise a vitamin deficiency may result.[10]

CHANGES IN METABOLIC PROCESSES

Metabolism is a term used to describe the various chemical and physical changes that food particles undergo in the body. It includes the changes by which these particles are built into the complex structure of the body cells, the changes that occur when stored particles are burnt up with liberation of heat and energy, and the changes leading to the elimination of various waste products.

For the performance of essential functions when at rest, the body requires a certain amount of energy for muscular movements such as those of the heart, and for the maintenance of body temperature. This is known as its basal requirement. Basal metabolism, therefore, refers to the combined chemical and physical changes that take place in the body when at rest. In determining basal metabolic needs, the subject is required to lie awake but completely relaxed, and the determination is usually made twelve hours after the last meal has been consumed

[10] E. J. Stieglitz, 'Nutrition Problems in Later Maturity', *Proceedings of the National Food and Nutrition Institute,* 69 (1952).

and several hours after the subject has participated in any strenuous exercise. There are normal variations in basal metabolism that depend on the size, shape and composition of the body, as well as its age. With increasing age, all metabolic processes go on much the same as in earlier years but at a reduced rate which is largely commensurate with reduced activity.

The metabolic rate is relatively high during the first two years of life and then decreases, although still remaining comparatively high until after puberty. During adult life there is a small but steady decrease until about forty-five years of age when the decrease becomes more pronounced with a marked drop during old age. This is undoubtedly due to lower muscular tone resulting from diminished muscular activity. In men sixty-five years of age, the basal metabolic rate is about 10 per cent less than in men twenty-five years of age. In women, the decline is somewhat less rapid up to the age of about forty-five years.[11]

Among other important physiological changes that occur during a lifetime is the decreased oxygen requirement per unit of body weight, oxygen being an essential requirement during the process of energy transformation in the body. This phenomena is now believed to be due more to a decrease in the total amount of active protoplasm than to a decrease in the oxygen requirement of the single cell. When this is coupled with decreased overall physical activity, it is obvious that there must be a decreased caloric requirement with age. In dealing with mixed populations, caloric requirements at forty-five and sixty-five years, respectively, may be 6 and 21 per cent less than those at twenty-five years.[12]

11 *Calorie Requirements* (Food and Agriculture Organization of the United Nations, Rome, 1957).

12 Ibid.

There is a striking resemblance between certain psychological changes that occur with age and in younger persons deprived of oxygen. In one study during which subjects were required to memorize several series of ten pairs of unrelated words, college students could remember approximately eight out of ten words whereas their professors, fifty-five to sixty years of age, could remember only about four or five. When the students were deprived of oxygen, however, their performance closely resembled that of their professors. Thus, the older man's decline in memory may be attributed to a slower passage of oxygen to the brain, coupled perhaps with impaired brain metabolism.[13]

A comparison of the effects of exposure to cold on old and young subjects has revealed that the old subjects were less able to maintain their body temperatures than the young.[14] The increased oxygen consumption that normally results from exposure to cold was found to exist in both young and old, although greater in the latter, particularly during the first half-hour of cold exposure. The more rapid commencement of increased oxygen consumption in the older subjects would suggest that the mechanism for the prevention of heat loss was less efficient in the old than in the young. Consequently, heat production commenced sooner during exposure to cold. This is in agreement with common experience for it is generally acknowledged that older individuals complain of chilliness more rapidly than young, and they frequently require more clothing, or other means of keeping themselves warm.

13 R. A. McFarland, 'The Psychological Aspects of Aging' from symposium on *Problems of Aging* (New York Academy of Medicine, 1955).

14 C. L. Krag and W. B. Kountz, 'Stability of Body Functions in the Aged', *Journal of Gerontology*, 5, 227 (1950).

CHANGES IN WORK PERFORMANCE

There are considerable differences in the capacities for work performance of men and women in the same age groups. When the performance of various age groups is compared there will almost certainly be many members of the youngest group who will perform below the average in the oldest group and many members of the oldest group who will perform better than the average of the youngest group. Hence, it is apparent that chronological age may be a poor indication of a person's performance capacity. Changes in performance with age are best studied on an individual basis although most of the published information refers to group averages.

Mental performance is a general term which covers such factors as speed, accuracy, learning and memory. As a person grows older, the speed with which mental tasks are performed is usually reduced and there may be a marked decline in accuracy and consistency. It seems that the loss in speed of the elderly is a phenomenon basic to mental events and one intimately involved in the ageing of the nervous system.[15] Older people work more as they feel and are less subject to temporary motivation.[16] Ability to learn shows a definite rise up to the age of about twenty-five years after which it begins to decline slowly. Nevertheless, the decline is such that no one under the age of about fifty years should refrain from endeavouring to learn for fear of being too old. Memory appears to become poorer after a person reaches late maturity, but the capacity for comprehension, reasoning

[15] J. E. Birren, W. R. Allen and H. G. Landau, 'The Relation of Problem Length in Simple Addition to Time Required, Probability of Success and Age', *Journal of Gerontology*, 9, 150 (1954).

[16] R. C. Hutchinson, 'Effect of Gastric Contents on Mental Concentration and Production Rate', *Journal of Applied Physiology*, 7, 143 (1954).

and judgment appears to be maintained at a relatively constant level as long as mental work and intellectual interests are maintained.

Several studies have been conducted to compare intelligence levels during adolescence, maturity and senescence. The results of these tests are in agreement and show that intelligence levels increase up to the age of about twenty years and then show a gradual but steady decline. It should be mentioned, however, that such tests involve time limits and these may tend to penalize the older person. On the other hand, the more complex the test, the more it depends on experience, judgment and reasoning and, in this respect, it would tend to favour the older person.[17]

The changes in vision that occur with age are well known. Loss of elasticity in the lens, resulting in a narrower range of accommodation, begins during childhood. A gradual decline in visual acuity for distant objects also takes place, becoming more pronounced after the age of about forty years. Another sensory change concerns hearing. In general, there is a definite, but relatively small, decrease in sensitivity confined mostly to the higher frequencies. Under some circumstances, this may be advantageous for it means that older persons experience relatively less difficulty in hearing in the presence of extraneous noises.[18]

The underlying physiological basis for the mental and sensory changes that occur in older people appear to be related to an interference in normal metabolic processes within the cells of the brain and central nervous system. This interference may operate through a reduced rate of supply of essential nutrients to these cells, or to a re-

[17] R. A. McFarland, *op. cit.*

[18] Ibid.

duced supply of oxygen. The problem is extremely complex and has not been satisfactorily investigated.

Reviews of the physiological aspects of ageing stress the gradual impairment of various organic functions with consequent reduction in performance capacities. The decrease in strength with age is one of the oldest accepted facts. Yet our understanding of the mechanism underlying this decrease is far from complete. There is a gradual rise in quickness of response from childhood to adolescence followed by a slow decline with advancing maturity. This suggests that older people should not be given tasks requiring continuous rapid action. They are better suited to operations that demand persistence and a high degree of accuracy. This has important implications for many skilled tasks in industry and elsewhere.

A decline in physical performance capacity with age does not take place in all aspects of physical work. For instance, although muscle strength may decrease with age, muscle efficiency appears to remain practically unaltered. Endurance for static work also remains unchanged although there may be a decrease in endurance for moderately heavy work. Regarding muscle co-ordination, there seems to be no change in the small muscles with age while co-ordination in the larger muscles is well maintained.[19]

The possibility of counteracting deteriorative changes in physical fitness by training is worth consideration. Few untrained younger men will match the performance of trained older men. On the average, a trained man of sixty will run faster than an untrained man of forty. This would only apply when the performance of the former had been maintained through continuous training during the years.

[19] E. Simonson, 'Changes in Physical Fitness and Cardiovascular Functions, with Age', *Geriatrics*, *12*, 28 (1957).

A reduction in physical performance capacity calls for a corresponding reduction in energy requirements. This can be taken care of by a reduced food consumption. Unfortunately, food consumption does not always decrease at the same rate as physical activity with the result that obesity, with all its handicaps, develops. Physical exercise does not prevent obesity but it appears to retard the wasting of muscle tissue characteristic of the normal ageing process. The fat-free body weight of physically active individuals does not appear to vary greatly with age.

At various times, consideration has been given to the possibility of using production data in the study of changes in occupational performance with age. Work of this kind involves many difficulties, both in the collection of results and their analyses, and in the interpretation of results. In one investigation, the production of women sewing machinists was studied for four eight-week periods. Peak production was reached around the age of thirty and at an age of about thirty-five a slow decline was observed.[20]

Another study was conducted in two printing works. Records of machine compositors, hand compositors and readers over a three-year period immediately following the introduction of incentive schemes were used. Declines of performance with age were small but noticeable from about fifty years of age onwards, except among older readers who maintained their output at a higher level than younger men until retirement. These results on highly skilled work were quantitatively similar to those of previous studies of semi-skilled work, although less marked.[21]

[20] H. F. King, 'An Attempt to Use Production Data in the Study of Age and Performance', *Journal of Gerontology*, *11*, B, 410 (1956).

[21] H. M. Clay, 'A Study of Performance in Relation to Age at Two Printing Works', *Journal of Gerontology*, *11*, B, 417 (1956).

Hence there is evidence that, whereas semi-skilled repetitive work may become a little more difficult as a man or woman becomes older, high-grade skills may continue unimpaired until the normal retirement age or beyond.

The readiness with which fatigue develops is perhaps the most striking of all changes that accompany old age. There is scarcely a book dealing with old age that does not present fatigue as the typical visible sign of the first approach of physical deterioration. There are two kinds of fatigue—physical and mental. It is easier to combat the first than the second although frequently they are very closely related. A person can cure physical fatigue by a certain amount of rest, depending on his degree of tiredness. Mental fatigue cannot be so easily relieved. To cure mental fatigue it is necessary to determine its origin and this is often part of an emotional complex.

3

Foods Having Special Claims

DURING recent years, a number of special nutrients and certain foods have been related to the span of life, either because they are believed to lengthen life or shorten it. In general, there is no scientific justification for claims that, in a properly nourished person, any particular nutrient or food can prolong life. But there is support for claims that certain nutrients, if consumed in excessive amounts, may play an important part in shortening life. The most important of these concern the solid animal fats.

FATS AND THEIR DERIVATIVES

Before fat can be absorbed into the body, the food of which it is part must be mechanically broken down by mastication. It is then emulsified (that is divided into very small globules which remain in suspension in the liquid contents of the bowel) and chemically digested (that is partly broken down into simpler units) by bile and other gastric juices in which there are minute quantities of several ferments produced in the cells of body tissues. The simpler units into which fat particles may be broken down are glycerol and various fatty acids which, after some further change and as part of a bile complex, pass through the intestinal wall into the blood stream. The remaining particles of finely emulsified fat, as well as the fat-soluble vitamins, pass directly into cells lining the intestinal wall and eventually into the blood stream.

After absorption, the finely emulsified fat and othe fatty materials are carried away by the blood stream t the liver and eventually deposited in various body tissue and in the body storehouses known as fat depots. Som of the fat remains in the liver where it is used to produc cholesterol, a synthesis that also takes place to a limite extent in a number of other organs. The exact relationshi between the amount of fat consumed and the productio of cholesterol is complex and not clearly understood The cholesterol produced is then excreted into th bile and eventually finds its way into the intestine wher it is mixed with any cholesterol consumed as a con stituent of food. Some of the cholesterol in the intestin is excreted, the remainder being absorbed into the bloo stream. Absorption is assisted by the presence of fat, decreased absorption probably occurring when the diet i low in fat.

There is now evidence of an association between th cholesterol content of the blood and heart disease, al though the evidence is rather conflicting. For instance heart disease can occur without an excessive amount o cholesterol in the blood; on the other hand, high level of cholesterol in the blood do not always result in hear disease. Furthermore, either or both conditions ma occur without high blood pressure, which is a majo cause of heart disease.

The form of heart disease that has one of the mos serious consequences consists of a thickening of the inne walls of the arteries owing to disordered cellular meta bolism resulting in an accumulation of fat, cholestero and other materials within the arterial wall. There ap pears to be a relation between the amount of fat in th blood stream and that in the arterial wall. As the condi tion becomes worse, the arteries become more and mor constricted allowing less and less blood to flow. If th

blockage is complete in a vital artery feeding the heart muscle, a heart attack occurs.

It would appear that children have the ability to absorb any fatty materials that may tend to accumulate in the arterial walls. As one grows older, this power of absorption seems to be gradually lost. At the same time, the concentration of cholesterol in the blood stream tends to increase, a fairly steady rise occurring from the age of twenty to about fifty-five years.[1] Thereafter, the level tends to fall, which is to be expected, if high cholesterol levels are associated with a reduced expectation of life.

Although it is generally agreed that persons with hardened arteries tend to have high blood cholesterol levels, it is still possible, as already mentioned, to have a normal level of cholesterol in the blood and yet have some of the other abnormalities that tend to promote a heart attack. Also, there are some people whose blood has a low level of cholesterol and the level remains approximately the same no matter what foods are consumed. These people, usually characterized by outstanding vitality, form a small minority. In others, the cholesterol level is high. High levels of cholesterol are sometimes hereditary and this could account for several members of the same family suffering from heart attacks.

Several years ago it was shown that vegetable oils and animal fats in the diet have different effects on the level of cholesterol in the blood.[2] In another study it was shown that the highest cholesterol levels occurred on diets high in animal fats and the lowest levels on completely vegetarian diets containing equivalent amounts

1 W. Hobson, *op. cit.*

2 L. W. Kinsell, J. Partridge, L. Boling, S. Morgen and G. Michaels, 'Dietary Modifications of Serum Cholesterol and Phospholipid Levels', *Journal of Clinical Endocrinology and Metabolism, 12*, 909 (1952).

of vegetable oils.[3] Later it was demonstrated that people on purely vegetarian diets had lower levels of cholesterol in their blood than people who were partial vegetarians and ate some dairy products.[4] Hence it is now generally accepted that solid fats tend to elevate the cholesterol level in the blood whereas certain liquid oils tend to depress it. Hence, as far as their effect on cholesterol is concerned, dietary fats have been roughly divided into two broad classes—hard animal fats and liquid vegetable oils.

There is, at the present time, some apprehension concerning the eating of animal foods rich in cholesterol, such as milk, eggs and liver. One of the reasons for this could be the popular reviews of scientific findings that have been neither up-to-date nor complete. This fear of eating foods such as the foregoing, may lead to poor nutrition for large numbers of middle-aged people who may, for various reasons, eat little meat. Until more scientific evidence is provided, there seems little justification for the elimination from the diet of foods high in cholesterol. In general, blood cholesterol levels do not vary with changes in the level of dietary cholesterol provided the variations are not extreme. In fact, a low cholesterol diet would probably result in more being produced in the body.

On the other hand, it has already been pointed out that the kinds of fat contained in a diet may have some effect on the cholesterol content of the blood. The reason for this has been explained as follows. The fatty acids, which form a part of all fats, both solid and liquid, may

[3] J. Groen, B. K. Tjiong, B. K. Kamminga and C. E. and A. F. Willebrands, 'The Influence of Nutrition, Individuality and some other Factors, including various forms of Stress, on the Serum Cholesterol', *Voeding*, *13*, 556 (1952).

[4] M. G. Hardinge and F. J. Stare, 'Nutritional Studies of Vegetarians: Dietary and Serum Levels of Cholesterol', *Journal of Clinical Nutrition*, *2*, 83, (1954).

be divided into two groups—the saturated and unsaturated. The first group is predominant in most solid fats of animal origin, such as butter, dripping and lard; the second group is predominant in vegetable oils, such as maize, peanut and olive.

The essential fatty acids which cannot be produced in the tissues, or only to an extremely limited extent, are all poly-unsaturated. Although their role in the body is still obscure, they appear to be necessary for the maintenance of a healthy condition of the skin, for growth and reproduction and for the efficient transport and metabolism of cholesterol. Because vegetable oils, such as those used for cooking purposes, contain more of the nutritionally essential poly-unsaturated fatty acids than animal fats, such as those used in the manufacture of spreads and shortenings, some people now believe that the consumption of vegetable oils should be increased at the expense of solid fats.

Oils with a high percentage of essential poly-unsaturated fatty acids are included in Table 1.

TABLE 1

*Poly-unsaturated Fatty Acid Content of Edible Vegetable Oils**

Oil	*Acid gms per cent*
Soya Bean	60.6
Cottonseed	49.7
Maize	42.3
Peanut	21.0
Olive	7.2
Coconut	2.5

* P. A. Stefanik and M. F. Trulson, 'Modifying the Fatty Acid Content of the Diet', *Journal of the American Dietetic Association*, *34*, 591 (1958).

From this table it will be seen that soya bean, cotton-seed and maize oils are outstanding sources of the poly-unsaturated fatty acids. Peanut oil is a very fair source. Still higher percentages are to be found in a number of less common vegetable oils such as grapeseed and walnut. The composition of all vegetable oils varies with the variety of the plant, the environment in which it is grown and the processing to which the kernels and oil were subjected. The above figures are, therefore, only approximate.

Both butter and margarine are poor sources of the poly-unsaturated fatty acids. Although some brands of margarine may be made wholly from vegetable oils, these oils become saturated during a hardening process to which they are subjected during manufacture. This process is necessary to convert all or part of the liquid oils to solid fats so that the finished product has the desired plasticity. It does not appreciably affect the digestibility or caloric value of the product. In some countries margarine containing unsaturated oils is marketed as well as cheese and several types of filled milk. The introduction of these products has been accompanied by a considerable amount of advertising. Many of the claims contained in the advertisements are, however, unsubstantiated and premature.

Because the fats contained in a Western-type diet are mainly of the saturated type—butter, margarine, shortenings and lard—and because a reduction in the fat content of this type of diet will, in many instances, reduce the level of cholesterol in the blood, the practical solution would appear to be to eat less fat rather than increase the consumption of unsaturated oils.[5] A fat-free diet would

[5] E. H. Hipsley, 'Some Observations on the Epidemiology of Coronary Heart Disease in Australia', *Food and Nutrition Notes and Reviews, 14*, 41 (1957).

not be satisfactory as some fat is necessary to provide sufficient of the essential fatty acids and for other reasons. Diets containing very small amounts of fat also have many disadvantages. Several such diets, containing considerable amounts of rice or fruit, have been devised. Unfortunately, it is difficult to make these diets palatable and to provide sufficient energy without excessive bulk.

Although the substitution of unsaturated vegetable oils for saturated fats is an effective dietetic treatment for the short-term reduction of cholesterol in the blood, it still remains to be satisfactorily demonstrated that a diet in which the fats consist largely of unsaturated oils can lower the cholesterol content of the blood for an indefinite period. Studies to date have been too short and too few in number to answer this important question.

Several reports have recently challenged the validity of the correlation between the consumption of total and saturated fat and the occurrence of hardening of the arteries. These reports have in turn been subject to much critical review. In evaluating this criticism, it is appropriate to note that the broad statistical data, despite their recognized limitations, have verified significant over-all correlations between death rates and the consumption of total calories, total fats and saturated fats.[6]

Although restrictions on the amounts of butter, margarine, shortenings and various meat fats may be advocated as an important step towards the prevention or postponement of heart disease, such restricted diets are not intended for growing children and adolescents, as the fatty acids normally found in an unrestricted diet are apparently favourable to their growth and development. After the period of growth is complete, and the body

[6] J. Stamler, 'Diet and Atherosclerotic Disease', *Journal of the American Dietetic Association, 34*, 929 (1958).

begins to lose its protective power over fats, then fat consumption could perhaps be gradually reduced.

There is some evidence that the availability of carbohydrate may also be a factor associated with the disturbed metabolism that eventually results in hardening of the arteries. To date, information on this aspect is very fragmentary.

Although most effort has been directed towards attempts to establish a link between heart disease and diet, other possible causes have received some attention. These include insufficient exercise, excessive weight, emotional stress and cigarette smoking. Evidence of a connecting link between heart disease and lack of exercise is convincing and cannot be readily discounted. Briefly, the reasoning behind such evidence is as follows.

One of the most significant ways in which living in the more advanced countries differs from that in the underdeveloped countries is in its degree of mechanization. Because of this, the theory has been advanced that lack of physical exercise, as well as dietary fat, could be a factor contributing towards heart disease in the more advanced countries. This is supported by the following observations. At one time, heart disease was more prevalent in the professional and clerical groups. In recent years more craftsmen have become affected due, it is thought, to increased mechanization in some crafts. If exercise is rigorous enough, there is no increase in the level of cholesterol in the blood even though calorie consumption may be very high.[7]

For a person beyond the age of thirty or forty years, the question naturally arises as to whether any damage

[7] G. V. Mann, K. Teel, O. Hayes, A. McNally and D. Bruno, 'Exercise in the Disposition of Dietary Calories: Regulation of Serum Lipoprotein and Cholesterol Levels in Human Subjects', *New England Journal of Medicine, 253*, 349 (1955).

already done to the arteries is permanent or curable. This question has not been answered with certainty. Experiments have shown the condition to be curable with animals and there are many authorities who believe that, because the condition is curable in animals, it is also curable in humans, even after it has become well established. This may be no more than hopeful thinking, and it may be many years before a satisfactory answer is obtained.

Research workers are searching diligently for some substance that will prevent fat and other materials from accumulating in the arteries and thus playing their part in promoting heart attacks. Some progress has been made but, to date, no substance has been found to be generally effective in most cases. A few have had very undesirable secondary effects.

A substance that has been found to have the power to reduce or prevent hardening of the arteries in experimental animals is lecithin.[8] Lecithin, a water-soluble derivative of fats, is an essential constituent of all living cells. It undoubtedly plays an important part in fat metabolism although its exact role has not yet been determined.

WATER AND BULK

Many investigators have emphasized the importance of water in the diets of older persons.

Water is not usually regarded as a nutrient because it yields no energy to the organism. Nevertheless it is needed for every chemical reaction in the body and is the vehicle in which food materials, internal secretions and various waste products are transported. It is also the

[8] L. M. Morrison, *The Low-Fat Way to Health and Longer Life* (New Jersey, 1958).

chief constituent of most of the tissues and so contributes to the structure of the body.

Water is the chief quantitative constituent of the diet. For the older person, about three and a half pints of water per day should be sufficient, although the exact amount would depend upon the individual and environmental factors such as temperature and humidity. In very hot weather, an increased consumption would be necessary. A reliable indication of whether sufficient water is being consumed is given by the amount of urine excreted. It has been stated that sufficient water should be consumed to allow a urinary output of at least two and a half pints per day.[9]

It is believed that the drinking of increased quantities of water is one of the most useful remedies for constipation. Nevertheless, many older people complain that they do not like water. This does not present a real problem because it is generally immaterial whether water is consumed as such, or as a pure fruit or flavoured milk drink, or other beverage. It is not difficult to make beverages attractive. Some solid foods also provide considerable amounts of water as shown by the following table. One seldom, if ever, hears of a person consuming water to excess, largely because of the body's ability to eliminate excess water, which is much greater than its ability to conserve water when the intake is inadequate.

Water Content of Common Foods

	per cent
Lettuce	95
Tomatoes	94
Cabbage	92

[9] N. G. Berk, 'The Principles of Sound Nutrition in the Aged', *Geriatrics*, *13*, 334 (1958).

	per cent
Carrots	90
Apricots	87
Apples	86
Oysters	80
Eggs	74

For most old people, it may be desirable that fluid intake, as well as the consumption of more solid foods, be spaced with small amounts taken at relatively frequent intervals rather than large amounts at infrequent intervals. The consumption of food and drink six times per day is for many people customary and convenient.

The older bowel, to a greater extent than that of a younger person, requires a certain amount of soft bulk in order to prevent constipation and the development of hard dry stools. Soft bulk is provided by the indigestible carbohydrate residue in foods. This is frequently referred to as fibre although 'roughage' and 'cellulose' are other terms sometimes used.

Plant fibre is necessary in a normal diet even though it has practically no nutritive value. It is not digested like sugars or starch although certain intestinal bacteria accomplish a softening and disintegration of the fibrous particles. It is because of its ability to absorb water and swell that fibre gives suitable bulk and consistency to faecal matter. Any normal diet will usually provide sufficient bulk for laxation. If not, the fibre content of a diet can be increased in the following ways:

(a) eating whole grain breads and cereals rather than those from highly refined grains;

(b) having three or four serves of fresh, preferably raw, fruit each day and consuming the skins if edible;

(c) including some raw vegetables, or a salad, in the dietary once or twice daily.

Bread, which is a staple commodity for large numbers of middle-aged and older people, can be of special value in the prevention of constipation. For reasons already discussed, it has been found that wholemeal breads tend to provide softer and bulkier stools than white bread. Such breads contain considerable amounts of fibre but it is in a very finely divided state and can be tolerated much better than, for instance, that in the stalks of vegetables such as celery or rhubarb.

In England it is widely believed that the decline in the sale of purgative drugs during World War II was due largely to the fact that people were less constipated because the flour from which bread was made was less refined than formerly. Furthermore, as the result of a dietary investigation, it was found that the less refined flour (80-85 per cent extraction) harmed no one suffering from any disease. Indeed, as far as some ulcerative states were concerned, it actually hastened the healing process.[10]

Milk, cheese, eggs and meat contain no fibre and for this reason are sometimes regarded as constipating. There is no scientific evidence to support this claim. In fact, these foods are excellent sources of some vitamins of the B group which have a role in the maintenance of a normal healthy condition of the intestinal tract. Meat may sometimes be described as fibrous but, when thus used, the term means stringiness and refers to texture rather than composition.

In recent years, some progress has been made in the correction of constipation by the consumption of special foods. The value of bran has been known to some people for many years, although others have found it especially

[10] Lord Horder, C. Dodds and T. Moran, *Bread* (London, 1954).

irritating. Occasionally a bran bolus may be formed which actually obstructs the bowel.

Some of the newer dietary methods are not used extensively because they involve foodstuffs that are not generally available on the open market. These include foods that provide considerable soft bulk such as brewer's yeast and tomato or citrus pulp.[11]

Powdered brewer's yeast is said to meet the needs of many older people who suffer from habitual constipation. Small amounts can be readily incorporated in such foods as soups, stews and gravies, and also in some baked foods.

The dried pomace from tomatoes and the peelings from citrus fruits after the juice has been pressed out both tend to maintain formed but soft stools. Both are rich in pectin but they are effective beyond their pectin contents since they serve much better than an equivalent amount of pectin, or of apple powder providing the same amount of pectin.

COMMON SALT

Common salt contains sodium, an essential element present naturally in many foods.

Sodium may be added to the diet in the form of salt both during the preparation and cooking of food and as a condiment. The consumption of salt depends largely on habit and individual taste. It is ordinarily consumed greatly in excess of requirements but the consumption level can be readily reduced by choosing different foods and reducing the amounts added to foods.

For most people, salt intake only needs consideration if abnormal quantities are lost in sweat during severe muscular exertion at high temperatures. Under these

[11] C. M. McCay, *Nutrition as a Factor in Aging*, Nutrition Symposium Series No. 3 (National Vitamin Foundation Inc., New York, 1951).

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circumstances, the ingestion of large quantities of water to relieve thirst is liable to produce severe fatigue and muscular cramp unless additional salt is also taken. The condition can be prevented by taking additional salt as well as water. During long periods of hot weather, and even without severe muscular exertion, the loss of salt in sweat could eventually exceed that consumed. In the case of the elderly and infirm, this may lead to quite serious muscular weakness and even cause heart failure. It can be prevented by giving more than the usual quantity of salt with food.[12]

The opinion is sometimes expressed that excessive ingestion of common salt may eventually lead to high blood pressure and heart failure. This is believed to occur mostly with people in sedentary occupations whose salt consumption has been far in excess of requirements over a number of years. The condition can usually be arrested by drastically reducing salt intake. Apparently, moderate restriction of salt is of no benefit in the prevention or treatment of high blood pressure.[13] Hence, although it may be a wise and reasonable precaution for healthy middle-aged and elderly people to avoid high salt intakes, nothing would appear to be gained by reducing salt consumption to very low levels except on medical advice.

Furthermore, as people grow older they become more set in their eating habits and would not take kindly to suggestions that they should change to diets very low in salt. Such diets taste very insipid, are unappetizing and would impose an almost intolerable situation for most individuals. They would also present a very serious problem in maintaining good nutrition because of the

12 C. and V. Stanton Hicks, *Food Facts* (London, 1958).

13 A. Keys, 'Nutrition for the Later Years of Life', *Public Health Reports, 67*, 484 (1952).

limited number of foods that could be consumed, many natural foods containing considerable amounts of salt.

The average adult consumption of salt is probably about a quarter to half an ounce, or one to two teaspoonsful per day. For most people, an average intake of about half this amount would be sufficient and would satisfy most tastes after consumption had been reduced to this level for a week or two.

FERMENTED MILKS

Nearly a century ago it was shown that protein foods putrefy in the large intestine and that during this process a number of poisonous substances are formed. Later it was discovered that the bacteria responsible for this putrefaction are susceptible to acid conditions and that the process can be suppressed by the addition of an acid, or sugar that produces acid on fermentation.

Some putrefaction in the lower part of the large intestine cannot be avoided. It is more marked when evacuation is slow than when it is normal. The resulting harmful effect is counteracted because absorption in the large intestine almost ceases when the contents become dry. The body also has an alternative method of defending itself against poisoning. If putrefaction is active, considerable quantities of gas are formed and, as this gas is highly purgative, rapid evacuation follows.

When it was learnt that centenarians were especially numerous in Bulgaria and that a fermented milk called yoghurt was the national food, a Russian biologist proposed that putrefaction in the large intestine could be suppressed by inoculating the intestine with this fermented milk product and that a prolongation of life would result.[14] Later it was found useless to use the

[14] E. Metchnikoff, *The Prolongation of Life* (New York, 1908).

bacteria in yoghurt for this purpose, as only bacteria natural to the intestine are effective. This led to the more recent development of another fermented milk preparation known as acidophilus milk. This product may be more effective in controlling putrefaction but there is no evidence that it prolongs life.

Both yoghurt and acidophilus milk are pleasant wholesome foods with slightly acid, nutty flavours. The principal product formed during fermentation is lactic acid and, in the case of another fermented milk product known as kefir, a small amount of alcohol. Their nutritive values would be slightly less than those of the milks from which they were prepared, yoghurt usually being prepared from concentrated milk. This would be owing to the loss of milk sugar resulting from fermentation. Because the protein is precipitated in a finely divided condition, all these preparations would be more readily digested than fresh milk.

OTHER SPECIAL FOODS

There is a large variety of other foods which, from time to time, have been advocated as prolonging the human life span. In general, there is no scientific evidence supporting claims that any of these foods prolong the life of healthy people on adequate diets. If the diet is deficient in a particular nutrient, then foods rich in this nutrient will certainly provide beneficial results.

For instance, beneficial results have been reported after the consumption of royal jelly, a secretion of the bee. Royal jelly is a food particularly rich in certain amino acids and any beneficial effects would almost certainly result from the consumption of these acids by people whose diets are low in the proteins that normally contain them. Honey would contain only very small

PLATE 1. Youth Participating in Healthy Activity

A basis for longer living is participation in healthy activities during the early years of life.

PLATE 2. Old People Leading an Active Life

amounts, the total protein content being less than a few tenths of one per cent.

It was once commonly believed that a high consumption of red meat was a factor contributing towards high blood pressure. There is no scientific evidence that the proteins in red or white meats have any adverse influence on blood pressure. Red meats, however, generally contain much more fat than white, and the belief could have, in some way, been related to the obesity that results from the over-consumption of fat. Even lean meat, from which all visible fat has been trimmed, contains considerable amounts of fat.

Many people believe in the old adage that 'wine is the milk of old age' and some people have faith in wine as a preventative against hardening of the arteries. For some middle-aged and elderly people, alcoholic drinks, consumed in strict moderation, could be of definite value. They would tend to promote appetite, remove wind from the stomach, give relief from worry and boredom, provide a few readily available and easily digestible calories and generally make life pleasanter. If consumed in excessive amounts, however, they could be very damaging and could promote many kinds of life-shortening maladies.

In a few instances, beneficial results have been reported from the consumption of soya bean products, presumably because of their high lecithin contents. It has already been pointed out that lecithin might be of value in reducing any accumulation of arterial fat. If this is so, then for some people, lecithin could have the effect of increasing the life span. Lecithin appears to owe its physiological action to a number of factors such as its emulsifying properties, its ability to be incorporated in vital body tissues, the part it plays in fat absorption, its role in the transport of various fatty materials in the blood stream

and its function during fat metabolism in the liver. Its action is different to that of other cholesterol-lowering agents which owe their effect to 'blocking' the absorption of cholesterol and possibly essential fatty acids.[15]

15 L. M. Morrison, 'Serum Cholesterol Reduction with Lecithin', *Geriatrics, 13*, 12 (1958).

4

Energy Requirements for Adults

THE work performed by the body is of two kinds—involuntary and voluntary. Involuntary work includes the activities of the circulatory and respiratory systems as well as those of digestion and absorption. Voluntary work includes the various activities—personal, occupational and recreative, in which a person is engaged each day.

For all forms of work, energy is required. This is provided in the first instance by the food consumed. In addition to providing energy for physical work, food provides heat that assists the body in keeping warm, and every possible activity is accompanied by the liberation of a certain amount of heat, the more strenuous the activity the greater the heat liberated. It is for this reason that people, when cold, involuntarily shiver, or they may voluntarily clap their hands or stamp their feet.

Energy needed for the performance of work, or for the provision of heat, is provided during the combustion of various constituents that are consumed by the body in the form of food. The energy thus released is measured in calories, a calorie being a unit of measure and not a constituent of any food. Fats are the richest source of calories providing about 255 Calories per ounce. Carbohydrates and proteins are poorer sources, each providing only about 113 Calories per ounce. When the fat, carbohydrate and protein content of a food is known, its caloric value can be calculated.

It is now well established that the combustion of

various food constituents is not a series of isolated pr
cesses. In most tissues, the energy for muscular activi
and warmth may be derived from carbohydrate, fat
protein. This is made possible by what has been terme
'the final common pathway of metabolism'. Into th
pathway there are drawn products from the partial met
bolism of all foods that yield energy. If, for any reaso
the supply of carbohydrate intermediates is interrupte
through their absence from the diet or otherwise, co
bustion is sustained by an increased utilization of oth
food constituents, in many instances, the fatty acids. Co
sequently, the composition of the combustible mixture
variable and determined by the proportions of th
various foodstuffs that are degraded to the point at whic
they are available for combustion.

The expenditure of energy, made available to the bod
during the process of combustion, may be considered
the sum of three components, namely,

(a) resting energy expenditure;
(b) energy expended during food ingestion;
(c) energy expended for physical activity.

The resting energy expenditure may be represented, as
first approximation, by the energy expended when
person is relaxed and warm in bed having not had an
food for a period of several hours. This expenditure, pe
unit of body weight, decreases regularly after the age
about twenty-five years, the decrease being more rapid i
men than in women. It is largely owing to a reduction i
the proportion of metabolically active tissue in the body

The energy expenditure associated with the ingestio
of food depends to some extent on the kinds of food co
sumed but, on an ordinary mixed diet, it is probably le
than 10 per cent of the energy value of the food met
bolized. It can, therefore, be taken at about 10 per ce
of the total energy expenditure, when an individual

caloric consumption equals his expenditure. For a meal rich in protein it may be much higher than this amount.

The expenditure of energy during physical activity depends to a large extent on body size and the amount of exercise taken. In fact, an appreciable amount of energy may be expended in moving the body or its parts. For a large number of adults, almost the only exercise taken in an otherwise sedentary life would be less than one hour's walking each day and, in many instances, this walking would consist of taking only a few steps at a time. For other adults, considerable energy may be expended during week-ends, either in some form of sport, or working about the home or elsewhere.

All energy expended by the body must be provided by food in sufficient quantity otherwise a caloric deficit will result. The energy requirements of individuals are determined by four variables. These are—

(a) physical activity;

(b) body size and composition;

(c) climatic environment;

(d) the individual's age.

The degree of physical activity is the most important factor influencing energy requirements. The others affect energy requirements largely, but not wholly, through their effect on physical activity. As people become older, they tend to engage in occupations that demand a smaller expenditure of energy and to reduce physical activity in non-occupational pursuits. When people engage in lighter forms of employment, or reduce unessential activities, they expend less energy and consequently need less in the form of food. Skill may also reduce the energy requirements for a specific task. On the other hand, there is some evidence that, in older persons, the effectiveness of muscular movements is reduced so that an older per-

son may have to expend a little more energy than a younger person employed on the same task.

Small people consume, and apparently require, less food than large people, all other conditions being equal. On the other hand, a very active small person could require considerably more energy than a large lazy person. For large numbers of middle-aged people in the more prosperous countries, body fatness tends to increase with age. This increases the weight and over-all size of the body and imposes an additional load on all body movements. Furthermore, there is evidence that muscular emaciation often accompanies increasing fatness, both being promoted by a more sedentary way of living. Under such conditions the requirement is for less food.

It is now generally recognized that people living in a hot environment eat less food than those living in a cold. This is a general observation which it is difficult to express in terms of energy requirements. It results from reduced physical activity and the need for less energy for warmth. Clothing and shelter are complicating factors since the degree of protection afforded by each profoundly affects energy requirements. In a cold environment, loss of body heat may be reduced by the use of heavy clothing. On the other hand, this clothing, like extra body fat, imposes an additional load on bodily movements for which more energy is required.

The caloric requirements of adults, according to age, are presented in the following table provisionally prepared by the Food and Agriculture Organization of the United Nations.[1] These requirements are intended for men and women living in a temperate zone with a mean annual temperature of 50°F. They are calculated figure

1 *Caloric Requirements* (Report of the Second Committee on Caloric Requirements, Food and Agriculture Organization of the United Nations, 1957).

and do not represent the degree of accuracy suggested by their specificness. Also, they are intended for fairly large groups of people and not for individuals. If they are applied to individuals, consideration must be given to normal individual variations.

The caloric requirements listed in Table 2 represent the needs of healthy individuals and are intended to provide a food intake that will enable them to lead active lives physically, mentally and socially, and to be successful in their occupational pursuits. No handicap through lack or excess of food is expected to be involved. There are many degenerative diseases that reduce vitality and, when these exist, caloric requirements could be much lower.

TABLE 2

Caloric Requirements of Adults

Age in years	*Men Calories per day*	*Women Calories per day*
20 - 30	3,200	2,300
30 - 40	3,104	2,231
40 - 50	3,008	2,162
50 - 60	2,768	1,990
60 - 70	2,528	1,817
70	2,208	1,587

It is important to remember, however, that diets may provide sufficient calories but yet be deficient in other respects.

Table 2 shows that, as one grows older, caloric requirements decrease. Accompanying this decrease there should be a gradual reduction in body weight. If there is no reduction, there will have been a replacement of muscle

tissue with fat, as discussed earlier. It has not been clearly established that this replacement adversely affects health and, for practical purposes, it is generally regarded as satisfactory if, after a person reaches his most desirable weight (that is the weight at which he looks and feels best), he maintains this weight for the rest of his life.

REDUCING EXCESS BODY WEIGHT

Many people tend to become obese as they approach middle age because the number of calories consumed as food is greater than the number expended during daily activities. Obesity means excessive fatness and this is indicated by excessive body weight. Nevertheless, it will be apparent that obesity and overweight are not necessarily identical.

Some adults are overweight as a result of substantial muscular development. When they exchange regular active exercise on the playing-field for a full-time sedentary job in an office, with perhaps one afternoon's sport per week and no reduction in food consumption, muscle is replaced by fat and obesity results. Yet there may be no significant change in body weight. To a lesser degree, many people who lead physically active lives during early adulthood and later reduce activity without a corresponding reduction in food consumption find themselves in a somewhat similar position.

Other causes of obesity are emotional in origin. Some middle-aged and older people eat constantly because they are bored and eating is a pleasant way of filling in time. Others eat a great deal because of loneliness, financial worries, or unhappiness about their accommodation or social position. People who overeat for such reasons should first solve their emotional problems before endeavouring to correct their dietary habits. They may require psychiatric assistance.

Another possible cause of obesity in elderly people is overfeeding by members of the family as a demonstration of care and affection. This frequently occurs when elderly people are living with their relatives. It would, in fact, be kinder if the younger people followed the elementary principles of nutrition and fed their elders only the quantities of food necessary for optimum health.

It is now generally accepted that obesity tends to shorten the span of life. There are many reasons for this. In the first instance, a person who is twenty pounds overweight is unnecessarily carrying about with him a load of twenty pounds. This requires the various muscles of the body and the circulatory and respiratory systems to undertake more work than is necessary, often to the point at which they are strained in doing so. Many physicians believe that the removal of excess weight, even when no disease is present, is good preventive medicine.

It has often been suggested that many of the ills which beset the ageing and aged are the result of over-nutrition with its consequent obesity. As the result of an extensive review of the literature, it has been shown that an increase in body weight elevates blood pressure whereas a decrease lowers it.[2] In addition, authorities generally agree that the average blood pressure of unselected groups increases with age. No virtue has ever been assigned to the continuous consumption of diets of high caloric value, although diets with just sufficient calories and a high percentage of good quality protein, mineral salts and vitamins have frequently been found to promote better health and well-being.

In the minds of many laymen, obesity and heart

2 C. M. Wilhelmj, J. McDonough and H. H. McCarthy, 'Nutrition and Blood Pressure', *American Journal of Digestive Diseases*, 20, 117 (1953).

disease are linked in much the same way as emaciation and tuberculosis were linked half a century ago.

Some middle-aged people, through having pendulous or protruding abdomens, may have the appearance of being obese when, in fact, they are not, or not to the extent indicated. The condition may result from a lack of tone in the abdominal muscles allowing the contents of the abdomen to fall forwards and downwards. One of the greatest helps in acquiring and maintaining abdominal control is the occasional voluntary retraction of the abdomen without expanding the chest. Apart from improving muscular tone, this movement, if repeated frequently throughout the day, will tend to remove any excess abdominal fat, for there is evidence that the frequent use of muscles in any region will result in the utilization of fatty deposits in that region.

A person's most desirable weight is the weight that favours good health and a long life: it is the weight at which a person looks and feels best. Height and weight tables for men and women of various builds are available[3] but they are of more limited value for the older adult than the young. Most people approaching middle age know whether they are overweight and a knowledge of body weights is only of value in keeping them informed as to whether their weights are remaining constant or changing. One of the most satisfactory means by which a person can determine whether he or she is overweight is to vary food consumption until the weight is attained at which the person looks, feels and performs best. Every effort should then be made to maintain this weight for the rest of his or her life.

Assistance in this respect could be provided by the use

[3] R. C. Hutchinson, *Food for Better Performance* (Melbourne, 1958).

of bathroom scales. Unfortunately, many bathroom scales on the market at the present time are unreliable. This means that most people wishing to rely on body weight determinations for preventing obesity have to use less convenient but generally more reliable public scales and weigh when fully dressed. In this case care is needed to ensure that the same clothing is worn each time a weighing is made.

Having established that a condition of obesity exists, the next step is to know how to reduce body weight without interfering with normal activities and performance. It is important that reduction be gradual, a loss of approximately one pound per week being the maximum amount frequently recommended. The procedure for removing excess body weight in otherwise healthy individuals is simply to reduce the amount of food consumed, particularly the amounts of fat and carbohydrate, so that the calories consumed as food are less than the calories expended during daily activities. Unfortunately for many people, the procedure is easier to comprehend than follow. If a reduction in food consumption does not result in a reduction in body weight, and in cases of very pronounced obesity, the advice of a physician should be sought. He may recommend a special reducing diet.

There are several types of reducing diets. One type allows moderate amounts of protein and carbohydrate but small amounts of fat. Another allows a liberal amount of protein, a moderate amount of fat and only a small amount of carbohydrate. For the mature adult, a reducing diet high in protein and low in fat and carbohydrate has much to recommend it. Unfortunately, as people grow older, they tend to consume high carbohydrate rather than high protein diets. This is largely because of the ease with which most carbohydrate food

can be masticated and the strong agreeable flavour of foods containing considerable amounts of sugar.

With increasing age, people become more fixed in their food habits and it is not as easy for an adult approaching middle age to follow a strict reducing diet as it is for a younger person. Hence, recourse must often be made to modifications of an existing diet by a reduction in the consumption of those foods that have high caloric values with, if necessary, compensating changes for any minerals or vitamins that are lost in doing so. Foods with low caloric values are given in Table 3; foods with high caloric values are given in the next section.

TABLE 3

Foods with Low Caloric Values

Food	*Calories*	
	No. per oz.	*Chief source*
Whole milk, fresh or reconstituted	18	Fat
All fruits and vegetables, fresh, frozen and canned	5 - 25	Carbohydrate
Fruit juices, unsweetened	5 - 15	Carbohydrate
(Bread, wholemeal)	(63)	Carbohydrate
Sea foods, except fatty varieties of fish	30 - 40	Protein
Poultry and game	40 - 50	Protein
Offal meats	15 - 45	Protein
Eggs, whole	46	Protein

Low calorie foods that derive most of their calories from fat are confined largely to whole milk, either fresh, or reconstituted from unsweetened condensed or

powdered milk. Sweetened condensed milk is of high caloric value because of the large amount of sugar it contains. Fruits and vegetables are low in calories because they contain very little fat but large amounts of water. The offal meats include tripe, brains, kidneys and liver. Although wholemeal bread has not a particularly high caloric value, it contains more calories per ounce than the other foods listed although less than white bread.

Bread and potatoes are often removed from reducing diets because of the numbers of calories they contain. But their caloric contents are not high and there is no more reason for excluding them entirely from a diet than any other staple food. Both are useful sources of minerals and vitamins largely because of the regularity with which they are consumed. The key to weight reduction is taking smaller portions at all meals with a bias towards the low calorie foods listed above.

During weight reduction, it is better to follow a gradual long-term programme rather than a programme designed to give results in a very short time. The reasons for this are as follows. In the first place, rapid weight losses are usually quickly regained because people do not have sufficient time to change their eating habits; on the other hand, gradual weight reduction permits the development of new eating habits. Secondly, with a slow but persistent reduction in food consumption, there is less discomfort from feelings of weakness and exhaustion. Finally, it has been claimed that wrinkling of the skin is avoided by a slow reduction in food intake.

It is possible to reduce appetite by means of drugs, but these frequently have unfavourable side effects and should not be used unless prescribed by a physician. Special reducing foods are expensive, unnecessary, and should be avoided. They are usually harmless but quite ineffective.

INCREASING BODY WEIGHT

The procedure for increasing low body weights is simply to eat more food. Emaciation resulting from insufficient food is not as common in countries with high living standards as it is in the under-developed countries. Nevertheless, it occurs to some extent in older people particularly, and more particularly if they live alone.

The reasons for emaciation resulting from insufficient food are usually complex and they may involve one or more of the following factors: poor eating habits, financial difficulties or carelessness concerning food. Poor eating habits may result from faulty training during childhood and adolescence, insufficient time to consume proper meals, or unjustified popular prejudices. Pensioners and others on restricted incomes, or with heavy family responsibilities, may not have sufficient money to buy all the food they need. People who are living alone, like the housewife who is alone at lunch time, will frequently not go to the trouble of preparing proper meals.

Height-for-weight tables can give a very rough indication of whether a person is underweight. They are seldom used for this purpose, however, because the person who cannot or will not feed himself sufficiently is not the sort of person who is likely to go to the trouble of checking his weight. If a person appears to be unduly thin, fatigues very easily and has little vitality, he is probably suffering from emaciation and it should not be difficult for him to determine whether this is the result of an insufficient consumption of food.

If there is no improvement when food consumption is increased, medical advice should be sought. Excessively thin people are more likely to be medical cases than fat people. All people have a desire for food which persists even after sufficient food has been consumed. There is

seldom a natural desire to starve, particularly if the body is already under-nourished.

To increase body weight, the consumption of larger amounts of food high in carbohydrate, and particularly fats, should be given special attention. Foods with high fat contents are listed hereunder, group A including foods high in animal fats which are normally solid, and group B, foods high in vegetable fats which are normally liquid. The reason for this division will be apparent from discussions in Chapter 3.

TABLE 4

Foods with a High Fat Content

Food	*Fat per cent*	*Calories per oz.*
A—containing animal fats		
Lard and dripping	99	253
Butter and margarine	85	214
Bacon, medium fat	45	130
Ham, deboned	38	114
Cheese, cheddar	35	118
Lamb cuts, boneless	34	104
Pork cuts, boneless	35	104
Cream, heavy	35	96
B—containing vegetable oils		
Cooking oils	100	255
Barcelona nuts	64	179
Almonds	54	166
Walnuts	52	146
Peanuts, roasted	49	160
Peanut butter	47	158

Foods with a high carbohydrate content are listed in Table 5, group A referring to partially refined foods con-

taining, in addition to carbohydrate, appreciable amounts of essential minerals and vitamins, and group B to foods consisting of wholly refined carbohydrates. If white bread is used, it should be a type that is fortified. To satisfy the appetite with foods from the latter group only would be to promote malnutrition.

TABLE 5

Foods with a High Carbohydrate Content

Food	*Carbohydrate per cent*	*Calories per oz.*
A—partially refined		
Cornflakes	85	107
Honey	76	84
Jams and jellies	71	72
Biscuits, wholemeal	65	135
Cake, plain	—	118
Bread, white	53	72
B—wholly refined		
Sugar, white	100	112
Barley sugar	100	112
Boiled sweets	97	106

In assessing the significance of the figures in the preceding tables, account should be taken of the amount of each food that can be conveniently consumed. For instance, more bread can be consumed than cake although the latter has the higher caloric value. In comparison with biscuits cornflakes are a very bulky food.

A weight-increasing diet, like a reducing diet, should be based upon the food guide given in Chapter 1. Although comparatively large quantities of food may be

PLATE 3. Ill Health and Inactive Old Age

Poor health, for which improper food habits could be partly responsible, restrict activities in later years.

PLATE 4. An Aged Filipino Chieftain

Unless disease intervenes, many primitive people on frugal diets live to a ripe old age.

consumed, quantity does not necessarily ensure that all essential nutrients are included, although the chances of this happening are more favourable than with a reducing diet. However, the matter is too important to be left to chance, and foods from each of the four food groups discussed in the food guide should be consumed in at least the quantities indicated. To these foods, high energy foods may be added to increase the consumption of calories above the level of those expended.

5

Desirable Feeding Patterns

THE feeding patterns and eating habits developed during childhood and adolescence can have a marked effect on the level of health during later years, ultimately influencing the duration of life. Poor eating patterns shorten life and, once they have become established, they are difficult to correct. It is important, therefore, that a feeding pattern involving sound dietary habits be fully developed during the early formative years of life.

During later life, changes in eating habits will almost certainly occur, either through necessity or choice and, although these changes may take place slowly, it will still be necessary to appreciate the importance of maintaining a sound dietary pattern so that each change can be given a slight bias enabling it to work towards this end. To assist in maintaining sound dietary habits, or correcting poor habits, an elementary knowledge of nutrition is desirable.

To some extent, feeding patterns depend upon the number and kind of meals consumed each day. In some under-developed countries, where it is customary to have only one large meal per day, it is impracticable to provide all essential nutrients in adequate amounts. Similar difficulties would exist if only two meals were consumed.

For many people, it is customary to have three meals per day and there are some people who actively discourage the consumption of food between these three meals. Nevertheless, during the past few years, it has be-

come common practice in offices, industry and the home to have, in addition, morning and afternoon snacks, and the popularity of light suppers appears to be increasing, particularly with older people.

Because morning and afternoon snacks, as well as suppers, are generally regarded as providing extra food, there is a natural tendency to restrict their size. Any such restriction would be unnecessary, however, if the amount of food consumed at the main meals were adjusted so that there is no appreciable increase in the total amount of food consumed. Snacks, and to some extent suppers, could then take a definite place in the daily dietary. They could be chosen as part of a planned food intake, and make a specific contribution towards daily food requirements.

ADVANTAGES OF SMALL MEALS

When the number of meals is increased, smaller quantities of food are required at each meal. The frequent ingestion of small quantities of food is an established practice in the feeding of infants, and adults suffering from certain digestive diseases. Nevertheless, such a regimen imposes a different set of conditions on certain bodily functions, such as the emptying time of the stomach. In comparison with large meals, small meals remain in the stomach for relatively long periods. This has been attributed to the fact that a greater amount of food causes greater distension of the stomach, which stimulates it to more effective contractions.

After a mixed meal of average size, the stomach empties in about three hours. The time seems to depend less on the individual than on the composition of the meal. Because women require less food than men, it is possible that their gastric emptying time is less, although the

smaller size of the stomach may have an opposite effect. High carbohydrate meals leave the stomach sooner than high protein meals and, although there is some evidence to the contrary,[1] it is generally agreed that fat delays the emptying time of the stomach. For meals of similar composition the emptying time does not appear to vary with age. When the stomach is nearly empty, hunger contractions set in. Consequently, they occur most quickly after those meals that take least time to leave the stomach.

On a number of occasions, industrial performance has been used to measure the effect on various operations of more frequent meals. In most instances, the additional meals have been provided in the form of morning or afternoon snacks. Although the ideal criteria for determining the effect of more frequent meals on human performance are those of actual practice under rigidly controlled conditions, such conditions are difficult to obtain outside the laboratory. Most investigations in industry, therefore, are open to criticism although, in many instances, every care has been taken to eliminate as many extraneous factors as possible.

The results of tests designed to determine the effect of the supplementary feeding of bananas, with and without milk, on women workers in industry point to a definite reduction of absence through illness as a result of such feeding.[2] The improvement was most marked for the women receiving both bananas and milk. It is possible that the improvement was partly due to an improved state of morale resulting from the more frequent consumption of food, although the extra food appeared to

1 R. C. Hutchinson, 'Meal Habits and their Effects on Performance', *Nutrition Abstracts and Reviews*, 22, 283 (1952).

2 L. Comstock and W. H. Eddy, 'The Effect of the Supplementary Rest Period Luncheon on Industrial Absenteeism', *Journal of the American Dietetic Association*, 11, 239 (1935).

be of some benefit. Since comparatively few subjects were tested, and the test periods were quite short, the results cannot be regarded as conclusive.

In another study on the effects of mid-morning and mid-afternoon feeding on the absenteeism of women clerical workers, it was found that groups receiving supplementary foods, also in the form of bananas, or bananas and milk, had a lower rate of absenteeism, apparently became less tired, were more cheerful, and paid more attention to their work.[3] Although other factors were undoubtedly involved, the results suggest that the extra food was a contributing factor.

In general, it has been shown that the introduction of rest pauses without food results in a definite increase in production and that the increase is only slightly greater after a rest pause with food. In fact, there is evidence that the ingestion of food is of less value than other conditions associated with the rest pause. Hence, in any consideration of the effects of mid-morning and mid-afternoon snacks on industrial productivity psychological, as well as physiological, aspects should receive consideration. It may not be the food but the accompanying break that is psychologically important under some circumstances.

It is claimed that a break after two or three hours' work in a factory or office has the following beneficial results which have particular application to the older and more established worker:

(a) it reduces boredom and fatigue, both mental and physical;

(b) it increases work output immediately after the break;

[3] H. W. Haggard and L. A. Greenberg. 'Between Meal Feeding in Industry', *Journal of the American Dietetic Association, 15*, 435 (1939).

(c) it provides a legitimate opportunity for social intercourse between employees;

(d) it assists in maintaining friendly relations between employer and employee;

(e) it brings about a reduction in accidents due to the human element.

Because of such advantages, it has been shown that the loss of working time due to mid-morning and mid-afternoon rest pauses, during which refreshments are taken, does not reduce work output but actually increases it.

During investigations on man's tolerance to cold, it was found that small meals spaced at short intervals were more favourable than large meals at the usual 4- to 6-hour intervals. From experiments on the effect of heat on man, it was concluded that small meals should be taken during work periods and larger quantities of food, if required, when the work is finished. Large meals were found to be undesirable because they may cause excessive sweating. Small meals at frequent intervals have been recommended for aviators in order to avoid post-prandial sleepiness and stomach distension, to diminish the effects of accelerative force and to enable aviators to be in constant readiness. Because small meals result in less production of gas which, in unpressurized planes, expands as the altitude becomes greater, they cause less discomfort than large meals of similar composition.[4]

It is thus seen, that for various kinds of work, in cold and hot environments and at high altitudes, there is evidence that more frequent meals are better than large meals spaced at long intervals. The scientific reasoning that is sometimes advanced in favour of such a regimen is that small amounts of food at frequent intervals keep the sugar in the blood at a more stable level, thus post-

[4] R. C. Hutchinson, *op. cit.*

poning the effects of acute hunger. Unless physical exertion is very strenuous, it is doubtful whether the sugar in the blood falls to harmful levels within a period of three or four hours.

DISADVANTAGES OF HEAVY MEALS

After the consumption of a heavy meal, such as the main meal normally consumed by a person on a regimen of three meals a day, there is generally a feeling of drowsiness, lack of co-ordination, and a disinclination for mental or physical activity. In offices and factories where the majority of employees have a full mid-day meal, the effect is shown on the production curve for the afternoon work period by a characteristic flattening for the first hour or so after the mid-day meal.

Several theories have been advanced to account for the lassitude, lack of co-ordination and disinclination for work experienced after large quantities of food have been consumed. One explanation is that there is a temporary 'brain anaemia' owing to demands for blood by the digestive organs. This means that there is a slightly greater concentration of blood in the vicinity of these organs, with a slightly smaller amount available to the brain.

The consumption of large meals at long intervals tends to accentuate fluctuations in heat production resulting from the consumption of food, and to reduce work capacity although this effect may be small and variable. The consumption of a large meal may also cause an immediate and considerable increase in heart activity and it has been suggested that the extra strain, when imposed on a diseased heart, would probably account for the attacks of heart disease which sometimes occur at this time.

It is sometimes claimed that large meals at long intervals give the stomach a chance to rest. But there is no evidence that the stomach needs long intervals between meals in order to rest, or that it ever rests when it has such intervals. Invalids, convalescents and patients with gastric ulcer are fed, not at long intervals to rest their weakened or diseased stomachs, but with small amounts of food at frequent intervals. It is large meals, not frequent meals, that impose a heavy burden on the stomach.

Typical production curves for routine industrial operations, when there are no rest pauses, show a marked increase in production rate during the early hours of the morning and afternoon and a decrease during the late hours. This general pattern appears most clearly for the heavier types of physical work but also exists for many forms of sedentary work. The prime cause of these variations is still obscure, although the increases have been loosely attributed to warming-up effects, and the decreases to fatigue or reduced motivation.[5]

The decrease in production rate during the late hours of the morning and afternoon, particularly for sedentary workers, may also be partly the result of a nervous condition which occurs when the last meal has practically disappeared from the stomach and hunger contractions have become pronounced. This condition comprises general irritability and restlessness, making continuous concentration on everyday matters increasingly difficult. There is experimental evidence that the condition improves when the long periods between meals are shortened.[6]

Large meals are physically inconvenient for people

[5] Ibid.

[6] R. C. Hutchinson, 'Effects of Gastric Contents on Mental Concentration and Production Rate', *Journal of Applied Physiology*, 7. 143 (1954).

working in a bent or crouched position. The inconvenience may be appreciable for sedentary workers, but it is most marked for activities requiring movement in a bent position. People engaged in such occupations seldom take large mid-day meals. For young people expending considerable energy, the physical inconvenience of large mid-day meals is minimized by consuming meals containing considerable amounts of fat. As a person grows older, the advisability of high fat meals is open to question for the reasons discussed in Chapter 3.

There is conflict of opinion as to whether strenuous exercise should be indulged in after a heavy meal. Apart from causing a mild increase in the concentration of blood in the vicinity of the digestive organs, large meals would tend to restrict breathing and, to the extent that this affects activity, would be detrimental. At high altitudes it could hasten the onset of mountain sickness. This normally occurs at an altitude of 5,000 feet, or above, through scarcity of oxygen.

DESIRABLE NUMBER OF MEALS

People having morning and afternoon snacks and a light supper, as well as three main meals, would be having six meals a day. This appears to be the maximum number that can be conveniently consumed in conformity with the modern way of life. Even so, a meal is regarded as any specific occasion on which solid food is ingested although, on some occasions, the quantity consumed may be quite small.

Morning and afternoon tea or coffee is not usually regarded as a meal unless it is accompanied by a solid portion of food such as biscuits, scones or cake. Nevertheless, tea or coffee, with milk and sugar, may provide an appreciable number of calories. The particular dis-

advantage of this kind of food is the very short time dur ing which it remains in the stomach and thus the littl effect it has on the postponement of hunger contractions In this respect, natural foods such as milk and banana are preferable. Both these foods take an appreciable tim to leave the stomach, the former because it curdles form ing a flocculent mass and the latter because of its solid structure.

Many people refrain from taking supper because it tends to have a disturbing influence on sleep. This may be so for a heavy meal requiring considerable digestion or producing large amounts of gas, but it has been found that a light supper consisting of a glass of warm milk and one or two biscuits may produce a more restful sleep than when no food is consumed.[7] The quantity of liquid that can be conveniently consumed is largely a personal matter and would probably become less as a person grows older.

Of the three main meals, breakfast is undoubtedly the most important. By breakfast-time it is usually ten or twelve hours since food was last consumed and the body's immediate reserves will have been practically depleted. Consequently, hunger contractions will be pronounced and, unless motivation is very strong, ability to work will be impaired until a proper meal is taken. It has been found that in those people who omit breakfast, the work rate is low and remains so until food is consumed. The provision of tea or coffee alone does not improve the position but a comparatively light breakfast will result in a significant improvement. The kind of food is not important, although for the daily diet to be adequate it

[7] G. Giddings, 'Child's Sleep: Effect of Certain Foods and Beverages on Sleep Motility', *American Journal of Public Health*, *24*, 609 (1934), and 'Normal Sleep Pattern for Children', *Journal of the American Medical Association*, *102*, 525 (1934).

is necessary for breakfast to contribute a definite amount of the day's nutrients and caloric requirements.

Although an important meal, lunch should be the smallest of the three main meals, partly because a large lunch or dinner would produce various degrees of lassitude and disinclination for activity and partly because it is physically inconvenient for people working in a bent or crouched position. The kind of food may not be important, although manual workers may find it difficult to consume sufficient calories without excess bulk unless their lunch includes considerable amounts of fatty foods such as butter and cheese. On the other hand, fatty lunches, consisting of such foods as ham sandwiches, may be inadvisable for sedentary workers, whose caloric requirements are low, partly because they tend to promote obesity and partly because of their possible role in hardening the arteries. For this class of worker, a salad type lunch would probably be best.

Dinner at night, which is generally more of a social occasion than the other meals, may be the largest meal of the day and should provide most of the remainder of the day's requirements of nutrients and calories. These should be determined from the daily food guide described in Chapter 1. Within reason, the more courses this meal comprises, the easier it is to provide the remaining nutrients. Three courses are common and generally satisfactory. These may consist of soup, a main course and a dessert, or a main course, a dessert, and fruit or cheese. Many soups have little nutritive value but serve a useful purpose as appetizers.

It is sometimes more convenient to have dinner in the middle of the day with tea at night. This is a common practice in small towns and other places where people live near their work and can return home at mid-day. It

is also common with many retired people who do not g
to work.

For most people at work, or with afternoon comm
ments, the practice is undesirable but, when it cannot b
avoided, it should be followed by a brief period of re
and relaxation by all middle-aged and older people.

Although the consumption of alcoholic drinks is no
recommended for young adults, it may, within stri
moderation, serve a useful purpose for older people. A
cohol provides readily available and easily digestib
calories, may stimulate a dulled appetite and temporari
improves a person's mental outlook. In large quantitie
alcohol can be very detrimental not only because of i
intoxicating effects but because it reduces appetite an
for a person on a low income, may take the place of mo
nutritious foods.

For the average healthy middle-aged man or woman,
daily dietary based on the following pattern should b
satisfactory. The diet is given only as an example of th
kinds of food that should be consumed and, for each foo
listed, similar foods could be substituted. It contains
small lunch and is comparatively low in fat. Quantitie
are not indicated as these would depend largely on th
individual.

Breakfast

Fresh fruit or fruit juice
Porridge with milk
Lean meat or fish
Bread
Tea or coffee

Morning Snack

Tea or coffee
Biscuits

Lunch

Unbuttered buns
Fruit
Tea or coffee

Afternoon Snack

Tea or coffee
Biscuits

Dinner

Soup or entrée
Lean meat, potatoes, two other vegetables
Dessert or biscuits and cheese
Tea or coffee

Supper

Milk or milk drink
Bread and jam

The above dietary may appear a little frugal for it was with this intention that it was planned. There is little doubt that a frugal type of diet is more conducive to longer living than a more elaborate diet and if one is hungry it can be enjoyed just as much, perhaps more.

6

Special Problems of the Aged

MANY old people are not as well nourished as they coul be although they may show no obvious signs of malnutr tion. Such levels of under nutrition frequently result in chronic tired feeling, anxiety over small things, a gloom outlook on life and, in some instances, obesity. On th other hand, proper nourishment keeps the body in goo condition and, in the event of illness, a well-nourishe body responds to treatment better than one that is ru down.

Correction of malnutrition is believed to present mor problems in the aged than in the middle-aged or young largely because of the complex physiological, psycho logical and sociological conditions involved. Poor nutr tion does not show its effects immediately. The result are frequently insidious, resulting in a slow day by da progress of tissue attrition and the gradual developmen of disorders. Often the obvious signs and symptoms d not appear until impairment of health is well advanced

Usually an old person is not as physically active as middle-aged person and fewer calories are needed. Al essential nutrients are still required—proteins for main tenance, and minerals and vitamins to keep the bod functioning properly. Hence the main difference betwee the food requirements of old and middle-aged people i that the former require less fat and carbohydrate. It i believed that a number of symptoms often ascribed t old age are caused by a deficiency of vitamins, and ther

is some evidence that, with increasing years, one of the B-vitamins may be required in slightly greater amounts.

Although vitamin intakes above estimated requirements have not been shown to prolong the span of useful living, it is generally agreed that certain needless concomitants of ageing may result from sub-optimum intakes. A vitamin of particular importance is vitamin B_{12}, a deficiency of which may result in pernicious anaemia with involvement of the nervous system. Surveys have shown that many old people have low levels of vitamin B_{12} in their blood, and recent reports suggest that there may be decreased vitamin B_{12} binding power of gastric juice, and impaired intestinal absorption.[1] In this respect, it is interesting to note that vitamin B_{12} is the only known nutrient which requires a specific gastric secretion to promote its absorption.

It has been shown that ageing is normally associated with an increase in the calcium content of some tissues and a decrease in others. Also, in some tissues, such as bone, there could be changes in the manner in which calcium is chemically combined.[2] It has been known for many years that the bones of old people break easily, a characteristic that could be due to the above factors, coupled, perhaps, with a deficiency of dietary calcium or some other nutrient intimately connected with calcium, such as vitamin D. There is no direct evidence that calcium requirements increase with old age.

It is the opinion of many nutritionists that the recommended calcium allowances for adults are in excess of actual requirements. If this is so, the excess may be sufficient to cover any additional calcium that could be required during old age. On the other hand, there is no

1 W. Hobson, *op. cit.*

2 E. J. Stieglitz, *Geriatric Medicine* (Philadelphia, 1943).

evidence that the recommended calcium allowances a detrimental to old people since the healthy body readi disposes of unwanted calcium by way of the bowe Urinary calcium may increase slightly but not in pr portion to the increased intake.

INDIVIDUAL FEEDING

The feeding of old people in their own home or tha of a relative is generally more satisfactory than grou feeding in an institution. The needs of each person can b considered separately and meals prepared accordingl with regard to both the kind of food served and th manner in which it is cooked. Meal times are usually le rigid, and the period over which a meal can be take more elastic.

When dietary changes are necessary, they can be intr duced gradually in accordance with the old person response to such changes. Unwise eating habits are be changed slowly for sudden changes in the mode of life o an old person can be very disturbing both physically an emotionally. The eating habits of a lifetime are no changed easily and people may rebel against too muc restriction or too great a change from accustomed food Quiet, persistent efforts will usually achieve the best re sults.

It often takes considerable time to repair the damag done through years of faulty eating. Frequently ol people become impatient because they do not realize tha time is necessary to restore physiological functions tha have become impaired during a long-drawn-out proces of malnutrition. Constipation may take many months t correct by dietary means, and it would be most unwis to remove excess weight by a drastic curtailment in th amount of food consumed.

Hence, it is apparent that the nutritional guidance of the aged involves much more than devising adequate diets to meet certain practical limitations. Nevertheless, the cost of certain foods, the amount of preparation required, the fuel needed for cooking, and the ease of consumption are all factors that must be taken into account before the aged can be properly advised on how to meet their dietary requirements. Some of these factors may not be important when other people are preparing the food or when finance is not too restricted.

On the other hand, for people on small incomes, high food costs can impose considerable hardship if they have no knowledge of what foods are nutritionally desirable, and if purchases are not made in accordance with preplanned menus. No matter what the financial position is, nor who prepares the food, menus should always be preplanned one week in advance. This usually involves little effort, for the quantities of many foodstuffs, such as bread and milk, would normally remain the same from day to day. Others, such as jams and sauces, would only be purchased as required. It is the main components of each meal that have to be pre-planned and, in estimating quantities, it is best to think in terms of serves rather than weight. For instance, for two people two chops may be more satisfactory than half a pound. Expensive foods are not necessarily the most nutritious.

Special methods of preparation are frequently the most satisfactory means of overcoming difficulties of mastication, and deeply ingrained prejudices. For instance, a soft diet that needs little chewing may be necessary to ensure adequate assimilation without chronic irritation. Such a diet can be readily prepared by pulping or straining the foods necessary for adequate nutrition. Unfortunately, the soft foods frequently consumed are not the most desirable as they are high in sugars and starch

and there is a tendency to substitute them for fresh fru and vegetables. Also many people associate fricassees a other dishes served in white sauce with hospital mea This prejudice can be readily overcome by colouring t sauce brown.

For ease of consumption, the elderly are apt to rely cheap, ready-to-eat foods such as those available fr cake shops. In consequence, there develops an asymmet dietary. With loss of teeth and dulling of taste sensitivi there is a natural tendency to consume sweeter foods su as iced cakes. This is an undesirable trend because su foods are frequently high in calories and comparativ low in essential nutrients, particularly proteins, miner and vitamins.

Because of these tendencies, the consumption of mo milk and bread fits the changing requirements of la years. Unfortunately, milk tends to be consumed in a quate amounts only by those people who developed t habit earlier in life. A large number of old people dri nothing but tea. Because of its comparative cheapn and ease of consumption, many old people rely on bre as their most important item of food. As a result, it h been argued that bread should include various additiv designed to give it the highest possible nutritive valu These additives generally increase its cost and may low its popularity and hence are not generally acceptab Many people like to think of bread as a basic food ma from flour, water, yeast and salt only.

Surveys conducted in Australia, Great Britain and t United States have shown that the diets of many o people are frequently deficient in citrus fruits and tom toes, yellow and green leafy vegetables and da products. Meat consumption is frequently low althou this is sometimes offset by a high consumption of chee

particularly in Great Britain, and fresh fish, both foods providing high quality protein and essential minerals.

The daily food guide described in Chapter 1 will assist in selecting the right kinds of food each day. To assist in the purchase of these foods, Table 6 has been prepared. On the other hand, the table may be used to compare the kinds and quantities of food already purchased, just to make sure there is not a deficiency in any important food, or in the quantities purchased. The amounts are for foods as bought or received into the kitchen. They make due allowance for bone, peelings and other inedible portions but not for spoilage or careless waste. The foods within each group are similar enough in composition to replace one another and should give ample choice for variety.

Both the low and moderate cost plans will meet all nutritional needs. The only difference, apart from cost, is that meals will be less varied in the former. If sufficient money is available, the moderate cost plan will provide larger amounts of meat, which may include some of the higher priced cuts, and a greater variety of fruits and vegetables. It is important, however, not to reduce the quantities of whole milk, or its substitutes, leafy green and yellow vegetables, and citrus fruits and tomatoes. The costing of each food plan was based on the small-scale buying that suits an elderly couple.

Many people wishing to lower caloric intake for the purpose of reducing body weight, or for other reasons, will prefer skim milk to whole milk. For the purpose of this table, one pint of skim milk may be reckoned as the equivalent of one pint of whole milk, although the former would have about half the caloric value. The equivalent amounts of condensed and powdered milks could be deduced from the directions for reconstituting these products given on their containers. A two-ounce

Table 6

Low and Moderate Cost Food Plans

Kinds of food	*Quantities of food required for one week*			
	Low cost plan		*Moderate cost plan*	
	Man	*Woman*	*Man*	*Woman*
Milk and Milk Substitutes	milk equiv.	milk equiv.	milk equiv.	milk equiv.
(a) Milk, whole or skim (b) Condensed or powdered milk, ice-cream	3 quarts	3 quarts	3½ quarts	3½ quarts
Bread and Cereal Products	bread equiv.	bread equiv.	bread equiv.	bread equiv.
(a) Bread and other baked goods (b) Cereals, spaghetti, macaroni	5 lb.	4 lb.	4 lb.	3 lb.

Fresh Fruits and Vegetables				
(a) Leafy, green and yellow vegetables	2½ lb.	2 lb.	3½ lb.	3 lb.
(b) Citrus fruits and tomatoes	2¼ lb.	2¼ lb.	2¾ lb.	2¾ lb.
(c) Potatoes and sweet potatoes	3¼ lb.	2½ lb.	2¾ lb.	2 lb.
(d) Other fruits and vegetables	2 lb.	1¾ lb.	3 lb.	1¼ lb.
Meats and their Substitutes				
(a) Meats, poultry and fish (b) Cheese and eggs	3½ lb.	2½ lb.	4¼ lb.	3½ lb.
Other Foodstuffs	not more than	not more than	not more than	not more than
(a) Butter, fats and oils	¾ lb.	½ lb.	¾ lb.	½ lb.
(b) Sugar, jams and honey	1 lb.	¾ lb.	¾ lb.	¾ lb.

serve of ice-cream may be regarded as roughly the equivalent of half a pint of milk.

In determining the equivalent food values for bread and similar baked goods, and cereal products such as rice, spaghetti, oatmeal and wheatflakes, one and a half pounds of bread may be regarded as the equivalent of one pound of these other foods. A more accurate comparison could be made by using flour equivalents. About five-eighths of the weight of a loaf of bread consists of flour, and the flour equivalent of other foods could be deduced from typical recipes.

For men, the foods listed would provide about 2,700 Calories and three ounces of protein per day, and for women about 2,000 Calories and two and a half ounces of protein per day after allowing about 10 per cent for wastage. These numbers of calories should be more than sufficient for most old people although there are, no doubt, some people whose requirements are greater than average, and whose consumption of food in one or more groups would need to be even greater than the quantities indicated. If skim milk replaces whole milk, the caloric values would be reduced by about 160-190 Calories.

'Other foodstuffs' include foods that are high in calories and should be used sparingly by people who are overweight and want to reduce. For people who are underweight and want their weight increased, foods high in calories may be consumed in amounts greater than those indicated. For cooking purposes, it would be better to use vegetable oils, such as maize or peanut, than solid animal fats, such as lard or dripping. They may be a little more expensive, but less is usually required.

Preparing meals for one or two people involves much less work than preparing meals for a family, but it has its problems, particularly for an elderly person who finds housework a burden or has no appetite for food. As

people grow older, senses of taste and smell tend to become dulled and foods containing more seasoning and flavour are required. One strongly flavoured food often makes accompanying bland foods more appetizing and a brightly coloured food may improve plate presentation.

Care should be taken not to buy more food than can be readily used. This may call for a new approach to buying if a person has been in the habit of purchasing for a family. Food in bulk, or in large economy-size packs, is not cheap if it becomes stale before it can be used. It is often more economical to purchase food in small lots. Even then, one small package may contain enough for four serves, that is, enough for two meals. It is better to become accustomed to think of food in terms of serves and when comparing prices, to compare the approximate cost per serve rather than the cost per pound.

If available, recipes for two, or the number of people concerned, should be used. Recipes for larger numbers, in which the quantities have been reduced, are not always satisfactory, largely because reduced quantities are sometimes difficult to calculate accurately and evaporative losses during cooking may be different. Larger quantities of food, with sufficient left over for the next day, can sometimes be used to advantage. It is the small quantities of food left over because of mistakes in calculating quantities that are the most difficult to use and they are frequently wasted.

Although a person may retire from business or professional life, he or she can never retire from the responsibility of eating properly. Diets that are too restricted or that omit certain wholesome foods because it is believed that they may not agree with a person are often an unnecessary handicap.

On the other hand, if a person reaches old age in good health, there is usually little reason for a change in diet

no matter what other people may advise, nor how ou rageous their diet may appear on superficial examinatio Experience has, no doubt, taught such people what the as individuals, seem to need. In the final analysis, it nutrients and not foods that are important.

GROUP FEEDING

Group feeding is of particular importance to the aged Although most old people prefer to remain at home o live with relatives or friends, they are often faced wit the indisputable fact that the only means by which the can afford to provide themselves with proper accommo dation, agreeable companionship and food service facil ties is to participate in some form of communal living.

This presents many problems to the person responsibl for feeding them. More than a knowledge of catering i necessary as many of the problems that arise require psychological approach involving tact and patience. A it may not be possible to study the peculiarities an characteristics of each person separately, an understand ing of the changed outlook that generally accompanie old age would be of value.

Because of their changed status, and the frequently un favourable attitude towards them, old people are often i the position in which the normal satisfaction of thei goals is no longer possible. The result is that their re sponses have many of the characteristics of a frustrate person. The latter often behaves in a more infantil manner than his intellectual level warrants. Hence, a old person who is basically unhappy may accept th statement that he must eat certain foods to maintai health but yet at meal time definitely refuse to eat single mouthful.

Such a person is simply expressing his inability t

achieve a satisfactory adjustment to his gradually deteriorating position by purposeless, regressive behaviour. Nor does he adopt this manner simply because he is old. Age is a contributing factor only in so far as it relates to his inability to attain the normal satisfaction of his needs. His whole mental outlook needs modifying and some degree of re-orientation. This requires persistent effort and time. On the other hand, marked improvement often results if such old people mix freely with others who have successfully achieved this readjustment. This is one important advantage provided by communal living.

With one or two minor modifications, catering for a group of old people should follow the same general principles as should be followed for any other group. Menus should be pre-planned one week in advance in accordance with the meal guide discussed in Chapter 1. Set menus should not be repeated at intervals shorter than about six weeks, and it is most important that the main component of a meal cannot be associated with certain days in the week. For some people fish on Friday is perhaps an exception.

For many old people meats should be minced or chopped finely. Vegetables should be mashed or sieved and stalks, such as celery or rhubarb, served as alternatives. Desserts with a milk base, such as creamed rice, are particularly suitable. All meals should be attractively presented, the size of serve being considerably smaller than for a younger person. Table appointments should be simple and easy to handle. Because of the unsteadiness of many old people, plastic table cloths that can be wiped over after each meal will be found serviceable and attractive.

A small meal, all of which is eaten, can be of much greater value than a large meal, of which only certain components are eaten.

Additional Reading

FOR those seeking further information on the importan of food in prolonging life, three references are reco mended. The first is an excellent historical account diet and longevity, the second is a general textbo covering many aspects of ageing, and the third has a us ful bibliography. They are: A. M. Beeuwkes, 'Ear Speculations in Diet and Longevity', *Journal of th American Dietetic Association, 28*, 628 (1952); E. J. Stie litz, *The Second Forty Years* (Philadelphia, 1952); H. M Sinclair, 'Nutritional Problems of the Elderly', *Moder Trends in Geriatrics* (London, 1956).

In addition, there are the following two references o more restricted interest: *Caloric Requirements* (Repor of the Second Committee on Calorie Requirements, Foo and Agriculture Organization of the United Nations 1957); and R. C. Hutchinson, 'Effects of Gastric Content on Mental Concentration and Production Rate', *Journa of Applied Physiology, 7*, 143 (1954).

Other interesting articles frequently appear in scientifi and medical journals, the two journals in which th greatest numbers of articles appear being *Geriatrics* an the *Journal of Gerontology*.

Footnotes throughout the text give references to othe publications that should be consulted for more detailed information on specific points.

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